

Evaluation of Concrete Seawalls at Perry's Victory and International Peace Memorial

by Roy L. Campbell, Sr., G. Sam Wong

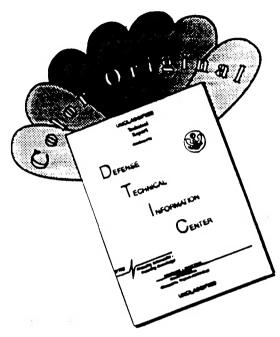
19960213 061

Approved For Public Release; Distribution Is Unlimited

DTIC QUALITY INSPECTED 4

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

DISCLAIMER NOTICE



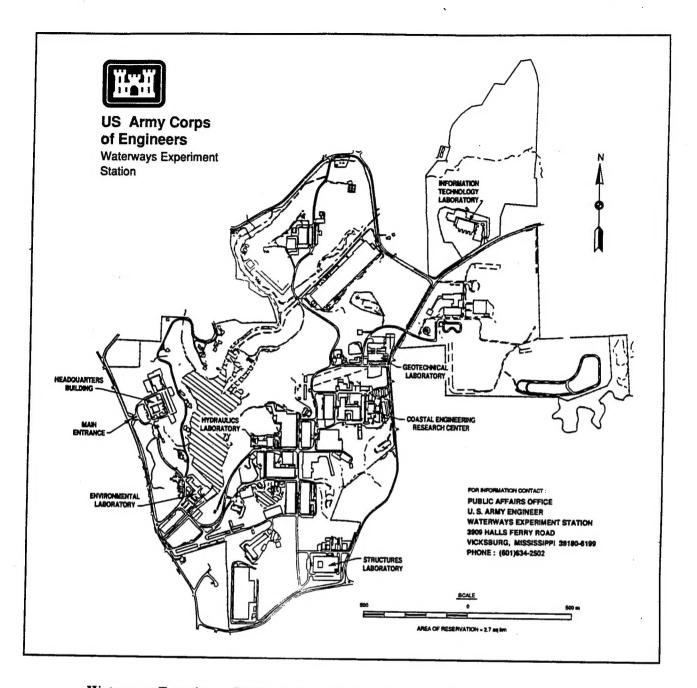
THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF COLOR PAGES WHICH DO NOT REPRODUCE LEGIBLY ON BLACK AND WHITE MICROFICHE.

Evaluation of Concrete Seawalls at Perry's Victory and International Peace Memorial

by Roy L. Campbell, Sr., G. Sam Wong U.S. Army Corps of Engineers Waterways Experiment Station 3909 Halls Ferry Road Vicksburg, MS 39180-6199

Final report

Approved for public release; distribution is unlimited



Waterways Experiment Station Cataloging-in-Publication Data

Campbell, Roy L.

Evaluation of concrete seawalls at Perry's Victory and International Peace Memorial / by Roy L. Campbell, Sr., G. Sam Wong; prepared for U.S. Army Corps of Engineers. 134 p.: ill.; 28 cm. -- (Miscellaneous paper; SL-95-5)

Includes bibliographic references.

1. Flood control -- Ohio -- Put-in-Bay. 2. Memorials -- Ohio. 3. Concrete walls. 4. Concrete -- Deterioration. I. Wong, G. Sam. II. United States. Army. Corps of Engineers. III. U.S. Army Engineer Waterways Experiment Station. IV. Structures Laboratory (U.S. Army Engineer Waterways Experiment Station) V. Title. VI. Series: Miscellaneous paper (U.S. Army Engineer Waterways Experiment Station); SL-95-5. TA7 W34m no.SL-95-5

Contents

Preface	iv
1—Introduction	1
Background	1
Seawalls	2
2—Field Evaluation	3
Visual Inspection	3
Concrete Coring	4
3—Laboratory Tests	29
Core Tests	29
Petrographic Examination	32
4—Conclusions	34
5—Recommendations	36
North Seawall	36 36
Overall	4°
References	43
Appendix A: Pulse Velocity Measurements	A ²
Appendix B: Petrographic Examination	B'
SF298	

Preface

The work described in this report was conducted for the U.S. Army Engineer District, Buffalo, and was part of an evaluation being performed for the U.S. Department of the Interior, National Park Service. This work was authorized by Military Interdepartmental Purchase Request (MIPR) NCB-MR-95-27EF. Messrs. Frank Lewandowski and Jon Kolber were the project points of contact for the Buffalo District. Mr. Ted Hillmer was the project point of contact for the National Park Service. Mr. Richard A. Lusardi, Superintendent at Perry's Victory and International Peace Memorial, was the field point of contact for National Park Service.

Mr. James E. McDonald was the principal investigator for the Structures Laboratory (SL), U.S. Army Engineer Waterways Experiment Station (WES). The report was prepared by Messrs. Roy L. Campbell, Sr., and G. Sam Wong, Concrete Technology Division, CTD. Mr. Campbell performed the visual inspection of the seawalls and selected coring locations. Mr. A. Michael Alexander, CTD, helped plan the nondestructive investigation, and Mr. Dan E. Wilson, CTD, made the ultrasonic pulse velocity measurements. Coring of concrete and testing of cores in compression were performed by Mr. Jimmy W. Hall III, CTD. The petrographic analysis was performed by Mr. Wong. The work was conducted under the general supervision of Mr. William F. McCleese, Acting Chief, CTD, and Mr. Bryant Mather, Director, SL.

Dr. Robert W. Whalin was Director of WES during the performance of this work. COL Bruce K. Howard, EN, was Commander.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

1 Introduction

Background

Perry's Victory and International Peace Memorial is located at Put-In-Bay, Ohio on South Bass Island in Lake Erie and is maintained and operated by the National Park Service. To protect the memorial from wave erosion damage, a seawall was constructed along the north shoreline. In 1977-78, the north seawall was modified to increase its elevation and length and a second seawall constructed along the south shoreline.

On 11 October 1994, Mr. Frank Lewandowski of the Army Engineer District, Buffalo conducted a visual inspection of the seawalls and found areas of distress and deterioration in the concrete. Based on this inspection, it was concluded that remedial action would probably be necessary sometime in the future and that a more extensive evaluation was required to determine the cause(s) of distress and deterioration and to detail remedial actions required.

The U.S. Army Corps of Engineer Waterways Experiment Station was requested in spring of 1995 to evaluate the concrete in the seawalls and to report the cause(s) and extent of concrete deterioration and proposed remedial procedures.

Seawalls

The north seawall contains 60 monoliths and has an approximate length of 580 m (1900 ft). Monoliths 1-17 and 42-60 are extensions to the old seawall and vary in length between 4.6 and 7.6 m (15 and 25 ft). Monoliths 18-41 are a part of the old seawall and are 15.2 m (50 ft) long.

The south seawall contains 73 monoliths and has an approximate length of 460 m (1500 ft). Most monoliths are 6.1 m (20 ft) long, except for a few that are 6.7 m (22 ft) long.

Lengths for monoliths were estimated from distances given in Appendix A, Tables A-1 and A-2 (Pulse Velocity Measurements).

Monolith Numbering

The monoliths for the north seawall were designated from east to west starting with monolith N1 and ending with N60. The monoliths for the south seawall were designated from west to east starting with monolith S1 and ending with monolith S73.

2 Field Evaluation

During the period 16-22 May 1995, a team from WES performed a visual and photographic examination of accessible concrete surfaces, made ultrasonic pulse velocity measurements across the top portion of walls, and took cores from the tops of seawalls in both distressed and nondistressed areas.

Visual Inspection

North Seawall

A visual inspection of the north seawall found that most of the distress and deterioration in the concrete was observed at the vertical joints. At a few of the joints, the distress was observed at both corners of the top surface and in the landside face (Figures 1 and 2). Localized distress was observed in the form of hairline cracks with a reddish-brown stain coming from some of the cracks at the ladder recess of monolith N22 (Figure 3). Moisture was retained in some of the aggregate visible in the surface of new borings (Figure 4).

There were a number of minor areas of distress observed along the north seawall. The distress appeared in the form of hairline cracks, staining, and popouts. Small areas of reddish-brown stains were observed coming from some of the random and traverse cracks.

All joint seals showed varying degrees of damage, deterioration, and adhesive and cohesive failures. At a few joints, the seal and filler materials were completely missing. Adjacent monolith ends at joints 3/4 through 6/7, 8/9 through 11/12, 13 /14 through 16/17, 42/43 through 44/45, 46/47 through 50/51, 52/53 through 55/56, and 57/58 through 59/60 were cast against each other. These joints had an approximate 2-in.-deep slot for joint sealant material.

South Seawall

A visual inspection of the south seawall found that most of the distress and deterioration in the concrete was observed along the top-lakeside edges at the vertical joints (Figures 5 - 8). Extensive cracking was observed in the tops of four monoliths, S7, S16, S17, and S20 (Figures 9 -14). Areas of reddish-brown stains were observed coming from cracking along a longitudinal plane in landside (Figures 10 and 11) and lakeside faces of these monoliths.

Moisture was retained in some of the aggregate visible in the surface of new borings (Figures 15 - 17).

There were numerous areas of minor distress in the form of hairline cracks, staining, and popouts. Small areas of reddish-brown stains were observed coming from random and traverse cracks.

All joint seals showed varying degrees of damage, deterioration, and adhesive and cohesive failures. At a few joints, the seal and filler materials were completely missing. Adjacent monolith ends at joints 1/2 through 4/5, 6/7 through 8/9, 10/11 through 13/14, 15/16 through 18/19, 20/21 through 22/23, 24/25 through 28/29, 30/31 through 38/39, 40/41 through 43/44, 45/46 through 48/49, 50/51 through 53/54, 55/56 through 58/59, 60/61 through 63/64, 65/66 through 68/69, and 70/71 through 72/73 were cast against each other (Figure 17). These joints had an approximate 2-in.-deep slot for joint sealant material.

Concrete Coring

Cores were obtained from a total of 24 locations (9 north seawall, 2 old seawall, and 13 south seawall). At three locations in the south seawall, the concrete broke up into such small pieces that a test core could not be retrieved. The core rig was moved landward at these locations and a second attempt made to obtain a test core. Three cores (N57, S8, and S68) were taken from areas that showed no distress. The results of coring are summarized in Tables 1 and 2.

Pulse Velocity Measurements

Ultrasonic pulse velocity measurements were performed in accordance with ASTM C 597 and taken at locations approximately 150 mm (6 in.) below the top of seawalls at 1.5 m (5 ft) intervals along the length of each monolith.

The resulting measurements are given in Appendix A.

A suggested scale for estimating the quality of the concrete using pulse velocity measurements (Leslie and Cheesman 1949) is given as follows:

<u>Ultrasonic Pulse Velocity, m/s (ft/s)</u>	Quality of Concrete
> 4,570 (15,000)	Excellent
3,660 - 4,570 (12,000 - 15,000)	Good
3,050 - 3,660 (10,000 - 12,000)	Questionable
2,130 - 3,050 (7,000 - 10,000)	Poor
< 2,130 (7,000)	Very Poor

A total of 66 locations (29 north seawall and 37 south seawall) where low pulse velocity readings were recorded are listed in Tables 3 and 4. All low readings were within 1.5 m (5 ft) of a joint, except for those taken in monoliths N24, S16, and S20. The low reading in N24 was suspected to be the result of a localized deficiency in the concrete.

Table 1 Field Notes	Table 1 Field Notes on Coring of North Seawall	
	Core Location	
Monolith	Reference Point	Description of Core
01N	North seawall joint 9/10	Rubble
11N	North seawall joint 11/12	Core length = 356 mm (14 in.)
N21	North seawall, near midlength of monolith	Core length = 483 mm (19 in.)
N22	North seawell joint at ladder recess	Core length = 432 mm (17 in.)
N30	North seawall joint 29/30	Core length = 381 mm (15 in.)
N38	North seawall joint 37/38	Core length = 190 mm (7-1/2 in.)
N45	North seawall joint 44/45	Core length = 384 mm (15-1/8)
N56	North seawall joint 56/57	Core length = 432 mm (17 in.)
NS7	North seawall joint 57/58	Core length = 426 mm (16-3/4 in.)
N34.	North seawall joint 34/35	Rubble
N40	North seawall joint 40/41	Core length = 102 mm (4 in.)
*Specimen	*Specimens taken from exposed landside top of old seawall at monolith location in new seawall.	n in new seawall.

Table 2 Field No	Table 2 Field Notes on Coring of South Seawall	
	Core Location	
Monolith	Reference Point	Description of Core
87	South seawall joint 7/8	Core length = 76 mm (3 in.)
88	South seawell, near joint 7/8	Core length = 483 mm (19 in.)
816	South seawall joint 15/16	Core length = 102 mm (4 in.)
\$16/17	South seawell at joint 16/17	Core length = 190 mm (7-1/2 in.)
S17A	South seawall joint 17/18	Rubbie
S17B	South seawall joint 17/18 (approximately 152 mm (6 in.) landward from S17A)	Core length = 375 mm (14-3/4 in.)
S20	South seawall joint 19/20	Core length = 76 mm (3 in.)
\$27	South seawall joint 27/28	Core length = 102 and 330 mm (4 and 13 in. lengths)
S37	South seawall joint 37/38	Core length = 381 mm (15 in.)
849	South seawall joint 48/49	Core length = 165 mm (6-1/2 in.)
S52A	South seawall joint 1/52	Rubbie
S52B	South seawall joint 51/52 (approximately 152 mm (6 in.) landward from S52A)	Core length = 292 mm (11-1/2 in.)
S60A	South seawall joint 59/60	Core length = 152 mm (6 in.)
S60B	South seawall joint 59/60 (approximately 152 mm (6 in.) landward from S60A)	Core length = 413 mm (16-1/4 in.)
898	South seawall joint, near midlength of monolith	Core length = 356 mm (14 in.)
S72	South seawell joint 72/73	Core length = 419 mm (16-1/2 in.)

Table 3					
North Se	awall Locations Wi	North Seawall Locations Where Low Pulse Velocity Measurements were Recorded	ty Measuren	ents were Record	led
	Location		Location		
Monolith	Distance From East End of Monolith m (ft)	Pulse Velocity m/s (ft/s)	Monolith	Distance From East End of Monolith m (ft)	Pulse Velocity m/s (ft/s)
NG NG	0.08 (0.25)	2918 (9573)	N21	0.08 (0.25)	2272 (7453)
N7	0.08 (0.25)	2052 (6731)	N22	0.08 (0.25)	ERR
88	6.10 (20.00)	2667 (8750)	N22	1.52 (5.00)	2223 (7292)
6N	0.08 (0.25)	2223 (7292)	N23	14.55 (47.75)	3419 (11218)
6N	6.10 (20.00)	2886 (9470)	N24	7.62 (25.00)	2646 (8681)
N10	0.08 (0.25)	ERR	N27	0.08 (0.25)	3334 (10938)
N10	6.10 (20.00)	ERR	N29	0.08 (0.25)	2223 (7292)
N11	0.08 (0.25)	ERR	N31	0.08 (0.25)	3252 (10671)
L LN	5.94 (19.50)	ERR	N31	14.63 (48.00)	1905 (6250)
N12	0.08 (0.25)	2667 (8750)	N33	6.10 (20.00)	2287 (7504)
N14	0.08 (0.25)	2825 (9269)	N38	0.08 (0.25)	2540 (8333)
N14	6.10 (20.00)	2381 (7813)	N59	6.10 (20.00)	2020 (6629)
N18	0.08 (0.25))	1990 (6530)	N60	0.08 (0.25)	ERR
N19	14.63 (48.00)	3293 (10802)	N60	1.52 (5.00)	ERR
N20	0.08 (0.25)	2963 (9722)			

Table 4					
South Se	South Seawall Locations W	Where Low Pulse Velocity Measurements were Recorded	ty Measuren	nents were Recor	ded
	Location		Location		
Monolith	Distance From West End of Monolith m (ft)	Pulse Velocity m/s (ft/s)	Monolith	Distance From East End of Monolith m (ft)	Pulse Velocity m/s (ft/s)
S1	6.02 (19.75)	1909 (6263)	S30	0.08 (0.25)	2623 (8607)
87	0.08 (0.25)	3310 (10860)	531	6.10 (20.00)	1702 (5585)
87	1.52 (5.00)	3293 (10803)	533	0.08 (0.25)	2229 (7312)
816	0.08 (0.25)	ERR	840	6.10 (20.00)	ERR
S16	1.52 (5.00)	2899 (9511)	S42	0.08 (0.25)	2036 (6679)
816	3.05 (10.00)	2241 (7353)	849	0.08 (0.25)	ERR
S16	4.57 (15.00)	2020 (6629)	S52	0.08 (0.25)	ERR
516	6.10 (20.00)	2015 (6612)	S52	6.10 (20.00)	2052 (6731)
517	4.57 (15.00)	ERR	823	0.08 (0.25)	2241 (7353)
S17	5.64 (18.50)	ERR	828	0.08 (0.25)	3239 (10628)
818	1.52 (5.00)	3200 (10500)	638	0.08 (0.25)	1861 (6105)
S18	6.10 (20.00)	1455 (4773)	098	0.08 (0.25)	2931 (9615)
S20	0.08 (0.25)	ERR	£9S	0.08 (0.25)	3362 (11029)
\$20	1.52 (5.00)	ERR	898	6.10 (20.00)	2500 (8203)
S20	3.05 (10.00)	ERR	298	0.08 (0.25)	1591 (5219)
S20	4.57 (15.00)	ERR	298	6.02 (19.75)	3266 (10714)
\$20	6.10 (20.00)	ERR	S72	0.08 (0.25)	ERR
S27	1.52 (5.00)	ERR	S72	6.10 (20.00)	ERR
829	3.05 (10.00)	3334 (10938)			

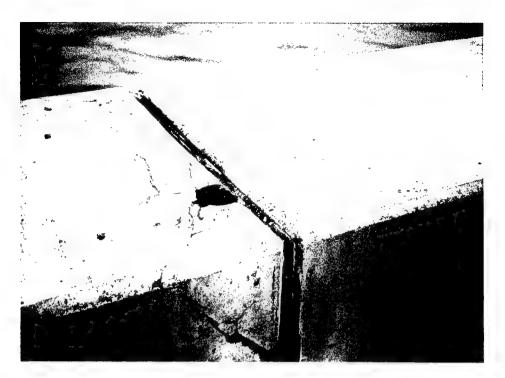


Figure 1. Cracking at joint 9/10, north seawall monolith N10

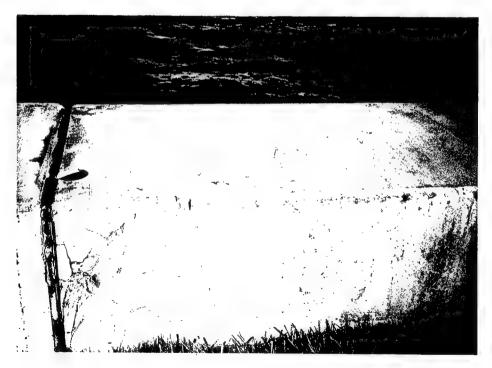


Figure 2. Cracking at joint 11/12, north seawall monolith N11

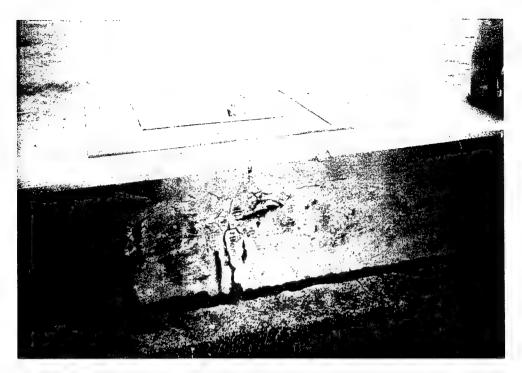


Figure 3. Hairline cracks with reddish-brown stains at ladder recess, north seawall monolith N22



Figure 4. Moisture retained in and around some of the aggregate particles visible in the surface of boring at joint 37/38, north seawall monolith N38

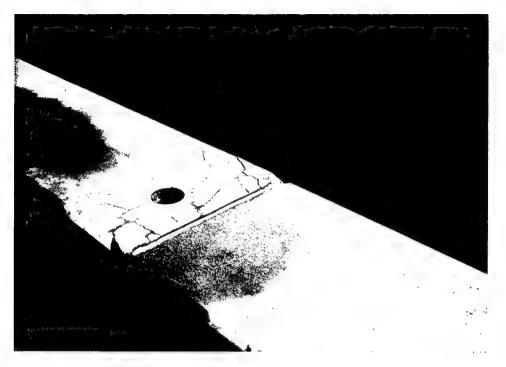


Figure 5. Cracking along lakeside edge at joint 48/49, south seawall monolith S49

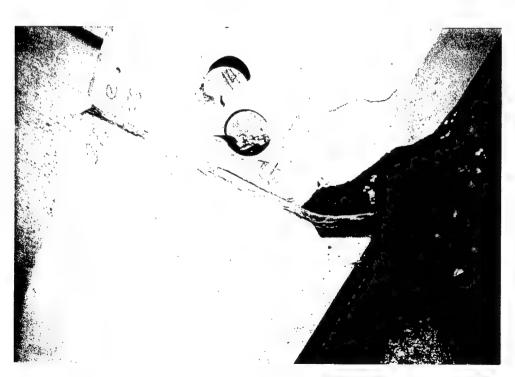


Figure 6. Cracking along lakeside edge at joint 51/52, south seawall monolith S52

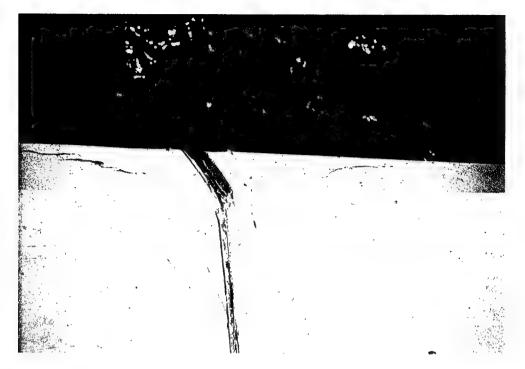


Figure 7. Cracking along lakeside edge at joint 52/53 south seawall monolith S52

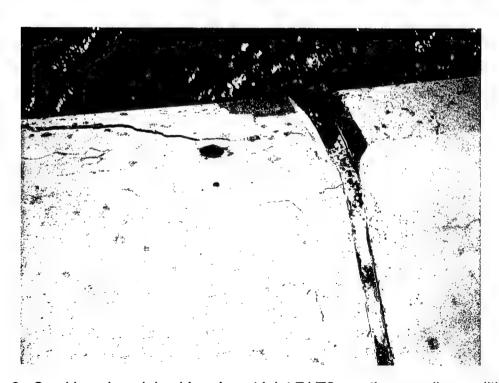


Figure 8. Cracking along lakeside edge at joint 71/72, south seawall monolith S72



Figure 9. Cracks and stains in top face of south seawall monolith S7



Figure 10. Cracks and stains in landside face of south seawall monolith S7



Figure 11. Cracks and stains in faces of south seawall monolith S17 at joint 17/18

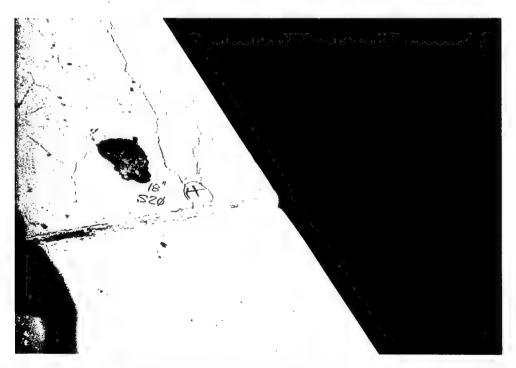


Figure 12. Cracks and stains in south seawall monolith S20 at joint 19/20

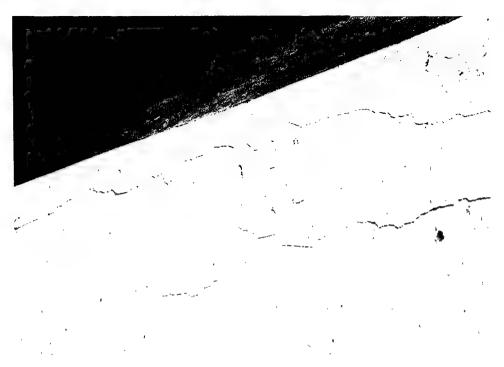


Figure 13. Longitudinal cracks along lakeside edge of south seawall monolith S20

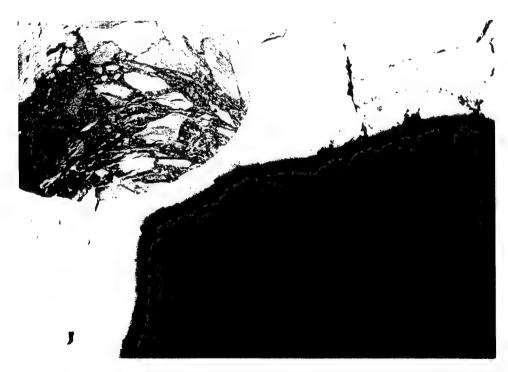


Figure 14. Cracks visible in the surface of boring at joint 19/20, south seawall monolith S20

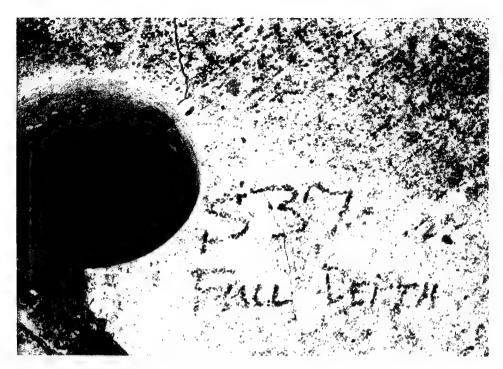


Figure 15. Moisture retained in and around some of the aggregate particles visible in the surface of boring at joint 37/38, south seawall monolith S37



Figure 16. Moisture retained in some of the aggregate particles visible in the surface of boring, south seawall joint 16/17



Figure 17. Monoliths 16 and 17 cast against each other, also moisture retained in and around some aggregate particles of monolith 16

3 Laboratory Tests

Core Tests

A total of 14 specimens (7 from each seawall) were selected from cores and tested in compression in accordance with ASTM C 39 and ASTM C 42. Ultrasonic pulse velocities and densities were also determined for each sample. The results of core tests are presented in Table 5.

Compressive Strength

The compressive strengths of the cores from the north seawall ranged from 31.7 to 58.7 MPa (4,600 to 8,510 psi) with an average strength of 46.0 MPa (6,680 psi). The compressive strengths of the cores from the south seawall ranged from 38.9 to 66.1 MPa (5,650 to 9,590 psi) with an average strength of 52.6 MPa (7,630 psi).

Pulse Velocity

The pulse velocity measurements on cores from the north seawall ranged from 4,182 to 4,803 m/s (13,720 to 15,758 ft/s) with an average velocity of 4,524 m/s (14,841 ft/s). The pulse velocity measurements on the cores from the south seawall ranged from 4,543 to 4,726 m/s (14,906 to 15,506 ft/s) with an average velocity of 4,623 m/s (15,166 ft/s). A correlation between compressive strength and pulse velocity is presented in Figure 18.

Density

The density of the cores from the north seawall ranged from 2.23 to 2.40 Mg/m³ (139 to 150 lb/ft³) with an average density of 2.27 Mg/m³ (142 lb/ft³). The density of the cores from the south seawall ranged from 2.23 to 2.37 Mg/m³ (139 to 148 lb/ft³) with an average density of the south seawall of 2.31 Mg/m³ (144 lb/ft³).

Table 5									
Test Res	sults for C	ore Specime	Test Results for Core Specimens taken from Seawalls	n Seawall	so.				
Core	Specimen	Mass Density	Pulse Velocity	Be	Before Capping		After Capping	ping	Unconfined Compressive
Location	Number	Mg/m³ (lb/ft³)	m/s (ft/s)	Length mm (in.)	Diameter mm (in.)	L/D Ratio	Length mm (in.)	L/D Ratio	Strength (ASTM C 42) MPs (psi)
N11	-	2.40 (150)	4,182 (13,720)	206 (8.10)	102 (4.00)	2.03	210 (8.28)	2.07	36.6 (5,310)
16N	-	2.26 (141)	4,803 (15,758)	203 (8.00)	102 (4.00)	2.00	206 (8.12)	2.03	50.3 (7,300)
	2	2.29 (143)	4,486 (14,717)	203 (8.00)	102 (4.00)	2.00	208 (8.20)	2.05	52.0 (7,540)
N30	-	2.23 (139)	4,705 (15,436)	206 (8.12)	102 (4.00)	2.03	209 (8.22)	2.06	58.7 (8,510)
N45	-	2.32 (145)	4,673 (15,331)	206 (8.10)	102 (4.00)	2.03	209 (8.21)	2.05	49.0 (7,110)
N56	-	2.24 (140)	4,341 (14,243)	205 (8.08)	102 (4.00)	2.02	208 (8.19)	2.05	31.7 (4,600)
N57	-	2.23 (139)	4,476 (14,684)	204 (8.02)	102 (4.00)	2.01	207 (8.16)	2.04	44.0 (6,380)
Averages for North Seawall		2.27 (142)	4,524 (14,841)						46.0 (6,680)
ď	-	2.23 (139)	4,580 (15,026)	207 (8.13)	102 (4.00)	2.03	209 (8.23)	2.06	53.4 (7,740)
3	2	2.24 (140)	4,613 (15,134)	201 (7.93)	102 (4.00)	1.98	207 (8.14)	2.04	49.3 (7,160)
S17B	-	2.26 (141)	4,658 (15,281)	205 (8.08)	102 (4.00)	2.02	208 (8.18)	2.05	54.0 (7,830)
S27		2.35 (147)	4,544 (14,907)	203 (8.00)	102 (4.00)	2.00	206 (8.11)	2.03	38.9 (5,650)
S52B	-	2.37 (148)	4,726 (15,506)	206 (8.10)	102 (4.00)	2.03	209 (8.24)	2.06	52.9 (7,680)
S68	_	2.31 (144)	4,694 (15,400)	206 (8.10)	102 (4.00)	2.03	209 (8.22)	2.06	66.1 (9,590)
S72	1	2.34 (146)	4,543 (14,906)	163 (6.40)	102 (4.00)	1.60	168 (6.61)	1.65	53.9 (7,810)
Averages for South Seawall		2.31 (144)	4,623 (15,166)						52.6 (7,630)

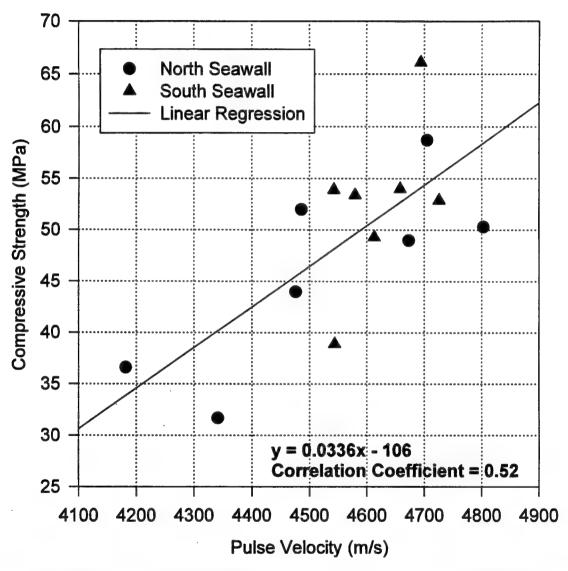


Figure 18. Compressive strength vs pulse velocity for core samples

Petrographic Examination

A total of 27 samples (9 north seawall, 2 old seawall, and 16 south seawall) were evaluated in accordance with ASTM C 856. The air content and the air-void spacing factor of the cement paste were determined in accordance with ASTM C 457 for selected concrete specimens removed from cores. Specific gravities and water absorption values for the coarse aggregate were determined in accordance with ASTM C 127 for selected individual aggregate particles removed from cores. The results of the petrographic examination of cores are detailed in Appendix B.

Cement Paste

The air-void content and parameters of the air-void system in the hardened concrete were determined in accordance with ASTM C 457. The concrete from the north and south seawalls and from old seawall contained some entrained air. The total air content ranged from a high of near six percent to a low of near one percent. Spacing factors showed a range of 0.780 to 0.213 mm (0.0307 to 0.0084 in.). The air-void system should have a spacing factor of 0.2 mm (0.008 in.) or less to provide adequate protection from stresses associated with freezing and thawing of critically saturated concrete.

Examination of concrete in adjacent monoliths indicated that one may be protected while the other may be susceptible to freezing and thawing deterioration. Samples from a core drilled through a joint representing concrete from monoliths S16 and S17 of the south seawall showed the spacing factor for concrete in monolith S16 to be significantly higher than that for monolith S17 (Table B-2, Appendix B). During the visual inspection of the south seawall, the concrete in monolith S16 at joint 16/17 was observed to be significantly more distressed than the concrete in monolith S17. Low pulse velocity readings were recorded in monolith 16 for the concrete near the joint.

Coarse Aggregate

Specific gravities of the coarse aggregate particles ranged from a low of 2.16 to a high of 2.89. The water absorption correlated with specific gravity in that particles with low specific gravities also indicated high absorption. The absorption ranged from less than one percent to more than eleven percent.

Aggregate particles with low specific gravities and high absorption usually are not resistant to freezing and thawing. In many places specific gravities of less than 2.4 are indications of potential problem aggregates. Problems associated with nondurable aggregate in this case would likely appear at edges and corners where the concrete has the highest potential for saturation.

The high absorption exhibited by some of the coarse aggregate particles may account for the popouts observed on concrete surfaces.

The dolomitic limestone showed some reaction rims around aggregate particles indicating some alkali-carbonate rock reaction. This reaction does not appear to be a problem as there was no evidence of joint closure in the structure or possible displacement.

Some alkali-silica reaction was observed in some near surface cracks. The gel in the concrete was limited to partially coating some fractures and appeared to be very limited in extent. From cores taken from old seawall, alkali-silica reaction was much more extensive in core sample N34 and was not evident in core N40 that was intact. The concrete was rubble where alkali-silica reaction was observed. Alkali-silica reaction may be a major deteriorating cause in the concrete of the old seawall.

Reinforcing Steel

Minor corrosion of the reinforcing steel was found in the limited samples taken. The corrosion does not appear to be the cause of distress in the concrete. As the structures age and the concrete along open cracks and adjacent to the reinforcing steel carbonates, corrosion of steel could become a problem causing staining and spalling of the concrete. Based on the results from the visual inspection, there is indication that this may be occurring in south seawall monoliths S7, S16, S17, and S20.

4 Conclusions

The results of the petrographic examination of the concrete identified several mechanisms that may contribute to the deterioration of the concrete. Of those, the lack of resistance to freezing and thawing was concluded to be the major contributor to the observed distress and deterioration in the concrete.

The air-void system in the concrete of some monoliths is inadequate for protecting the concrete from damage due to freezing while critically saturated. An examination of selected specimens indicated the concrete from some monoliths has an air-void spacing factor near the critical limit where the concrete would be considered protected while the concrete from other monoliths has an air-void spacing factor that is well outside the protected range.

Both the concrete from the north and south seawalls were similar in composition. The performance is expected to be similar under similar environmental conditions. Both walls contain some aggregate particles that are susceptible to damage due to freezing and thawing while critically saturated. This may manifest itself in D cracking of the concrete at the joints and edges.

Alkali-aggregate reaction and corrosion were recognized as active chemical reactions in the concrete but are believed to be minor contributors to the deterioration process at this time. Of the two cores obtained from the old seawall, one was intact and free of apparent internal distress where the other was totally deteriorated. Only limited consideration was given to the old concrete and alkali-silica reaction may be a factor in deterioration of that concrete. Overall, the deterioration resulting from alkali-silica reaction is not expected to require remedial action in the future.

During the visual inspection of the seawalls, it was observed that a much higher frequency of the distress exists in the south seawall concrete than in north seawall concrete. An increase in damage has been observed in the south face of other structures that lie in a east-west plane. It is believed that the south face of these structures receives more sunlight in the winter than the north face due to the angle of the sun and, thereby, undergoes more cycles of freezing and thawing. This may account for the increased frequency of damage observed in the south seawall.

Most of the distress and deterioration in the concrete was observed along the top-lakeside edges of seawalls at the joints. The exceptions to this were at four south seawall monoliths (S7, S16, S17, and S20) where the damage was distributed

along the length of the monoliths and at a ladder recess in the north seawall monolith N22 where more extensive cracking was observed in top and landside faces of the concrete.

Corrosion of the reinforcing steel was indicated in the four south seawall monoliths by areas of reddish-brown stains coming from cracking along a longitudinal plane in landside and lakeside faces. Reddish-brown stains were also observed coming from cracks in the concrete at the ladder recess of north seawall monolith N22.

There were numerous areas of localized distress in the form of hairline cracks, staining, and popouts. Small areas of reddish-brown stains were observed coming from random and traverse cracks indicating localized corrosion of the reinforcing steel. Again, most of the distress was observed in the south seawall. It is possible that some areas of localized distress will required remedial action in the future for appearance purposes.

All joint seals showed varying degrees of damage, deterioration, and adhesive and cohesive failures. At a few joints, the seal and filler materials were completely missing. No correlation could be made between the missing joint materials and the occurrence of damage to the concrete as there were several joints where there was no joint material and no evidence of distress or deterioration.

5 Recommendations

North Seawall

There are eight locations in the north seawall where removal and replacement of distressed and deteriorated concrete should be considered (Table 6). All but one location is at a joint. In general, it is recommended that for repairs at a joint the concrete be removed and replaced from the joint back approximately 610 mm (24 in.) and from the top down approximately 380 mm (15 in.). For the repair at the ladder recess in monolith N22, it is recommended that approximately 380 mm (15 in.) of the concrete be removed and replaced from the vertical face between the top and ground level and 300 mm (12 in.) to either side of ladder blockout.

South Seawall

There are forty locations in the south seawall where distressed and deteriorated concrete should be consider for removal and replacement (Table 7). Four locations (monoliths S7, S16, S17, and S20) include removal and replacement of the top 460 mm (18 in.) of the monolith and the other thirty-six locations are for repairs at a joint. In general, it is recommended that for repairs at a joint the concrete be removed and replace from the joint back approximately 610 mm (24 in.) and from the top down approximately 380 mm (15 in.).

Table 6 Recomn	Table 6 Recommended Repairs to	s to North Seawall
Monolith	Reference Point	Description of Repair
,01N	Joint 9/10	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
"01N	Joint 10/11	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
N11.	Joint 10/11	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
N11.	Joint 11/12	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
N14.	Joint 13/14	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
N22.	Joint 21/22	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
N22	Ladder Recess	Remove and replace approximately 380 mm (15 in.) of concrete from vertical face between the top and ground level and 300 mm (12 in.) to either side of ladder blockout
.09N	Joint 59/60	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
Low Pulse	Low Pulse Velocity Measurement	ont

Table 7 Recomn	Table 7 Recommended Repairs to	s to South Seawall (Continued)
Monolith	Reference Point	Description of Repair
S1.	Joint 1/2	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.) and make joint vertical at top
\$7*	Entire Monolith	Remove and replace top 460 mm (18 in.) of monolith
S16°	Entire Monolith	Remove and replace top 460 mm (18 in.) of monolith
\$17.	Entire Monolith	Remove and replace top 460 mm (18 in.) of monolith
\$18	Joint 18/19	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$20	Entire Monolith	Remove and replace top 460 mm (18 in.) of monolith
S27	Joint 27/28	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$29	Joint 28/29	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$30	Joint 29/30	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
531	Joint 31/32	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S32	Joint 32/33	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
533.	Joint 32/33	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S33	Joint 33/34	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$34	Joint 33/34	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
Low Puise	Low Pulse Velocity Measurement	nt

Table 7 Recomr	Table 7 Recommended Repairs to	s to South Seawall (Continued)
Monolith	Reference Point	Description of Repair
537	Joint 37/38	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
538	Joint 37/38	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
839	Joint 38/39	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
839	Joint 39/40	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
840	Joint 39/40	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$40	Joint 40/41	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S41	Joint 41/42	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$42	Joint 41/42	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S42	Joint 42/43	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
543	Joint 42/43	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
846	Joint 45/46	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S49°	Joint 48/49	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$52	Joint 51/52	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$52	Joint 52/53	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S53°	Joint 52/53	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
Low Pulse	Low Pulse Velocity Measurement	Į.

Table 7	7	
Recom	Recommended Repairs to	rs to South Seawall (Concluded)
Monolith	Reference Point	Description of Repair
S53	Joint 53/54	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
828	Joint 57/58	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
.628	Joint 58/59	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
°098	Joint 59/60	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S63°	Joint 62/63	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
S63°	Joint 63/64	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
864	Joint 63/64	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
.267	Joint 66/67	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$67	Joint 67/68	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
\$72.	Joint 71/72	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
572.	Joint 72/73	Remove and replace from joint back approximately 610 mm (24 in.) and from top down 380 mm (15 in.)
Low Puls	Low Pulse Velocity Measurement	nt

Overall

Additional removal and replacement will be required if sound concrete is not reached within specified repair limits. A minimum 25 mm (1-in.) saw cut should be made along removal boundaries to reduce the occurrence of feather edges during removal. If damage to a reinforcing bar has reduced the effective cross-sectional area by 25 percent or more, additional reinforcement should be added. Exposed concrete surfaces and reinforcing should be sandblasted prior to placement of concrete.

A conventional concrete should be used to make repairs. The concrete should have adequate air content to protect repair against freeze-thaw damage. The coarse aggregate should be tested for resistance to freezing and thawing (ASTM C 666, Procedure A).

Cracking has been a problem in some overlays and large repairs. It is believed that the cracking was the result of thermal and drying volume changes acting upon the highly restrained repair. To reduce the potential for such cracking, positive steps should be specified and followed to minimize temperature differentials and shrinkage. Reduced cracking in lock wall resurfacing has been attributed to lowering cement content, increasing the maximum size coarse aggregate, utilizing lower placing and curing temperatures, and paying close attention to curing (Wickersham 1987).

It is recommended that a surface sealer be applied to monolith tops and to lakeside and landside faces from top of monolith to minimum of 460 mm (18 in.) below. The sealer selected should allow significant water vapor transfer to avoid a critically water saturated condition that would result in damage due to freezing and thawing. Criteria for selection of sealers along with the test results of some 90 commercial surface treatment products can be found in Technical Report REMR-CS-17, Report 2 (Husbands and Causey 1990). Of the products tested only five products met the criteria (one hydrocarbon, two siloxanes, and two silanes). The manufacturer will have to be contacted regarding conditions under which a particular sealer can be applied as the application varies greatly between types of sealers.

It is also recommended that existing seals be removed and new seals installed at all joints.

Additional evaluation of the seawalls may be required as the lakeside faces of seawalls were not accessible due to high lake levels when field evaluation was performed. It is expected that the concrete in the lakeside surfaces has less than or minimal resistance to freezing and thawing damage when critically saturated. Therefore, it may be prudent to apply sealer to the full height of lakeside surfaces. The concrete in the sidewalk portion of the south seawall was not tested. The sidewalk did have minor cracking at the corner of one joint. The repair of this corner would only be necessary for appearance.

Maintenance

Because of the inadequate air-void system within the concrete, there is potential for the deterioration due to freezing and thawing to continue in what is now sound concrete, assuming critical saturation of the concrete. To minimize this potential, it is recommended that the sealer be reapplied periodically. The time interval between applications depends on the product used. For many sealers, the recommended interval is 5 years.

References

American Society of Testing Materials. 1994. <u>1994 Annual Book of ASTM Standards.</u> Philadelphia, PA.

- a. Designation C 39. "Standard test method for compressive strength of cylindrical concrete specimens."
- b. Designation C 42. "Standard test method for obtaining and testing drilled cores and sawed beams of concrete."
- c. Designation C 127. "Standard test method for specific gravity and absorption of coarse aggregate."
- d. Designation C 457. "Standard practice for microscopical determination of air-void content and parameters of the air-void system in hardened concrete."
- e. Designation C 597. "Standard test method for pulse velocity through concrete."
- f. Designation C 666. "Standard test method for resistance of concrete to rapid freezing and thawing."
- g. Designation C 856. "Standard practice for petrographic examination of hardened concrete."
- Husbands, T. B. and Causey, F. E. (1990). "Surface treatments to minimize concrete deterioration, laboratory evaluation of surface treatment materials," Technical Report REMR-CS-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Leslie, J. R. and Cheesman, W. J. (1949). "An ultrasonic method of studying deterioration and cracking in concrete structures,: ACI Journal, *Proceedings*, Vol 46, No. 1, pp 17-36
- Lewandowski, F. (1994). "Inspection and preliminary evaluation of concrete seawalls at Perry's Victory and International Peace Memorial, Put-in-Bay, (South Bass Island) Ohio," US Army Corps of Engineers District, Buffalo, Buffalo, NY (Unpublished.)

Wickersham, J. (1987.) "Concrete rehabilitation at Lock and Dam No. 20, Mississippi River," The REMR Bulletin, Vol 4, No. 4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Appendix A1 Pulse Velocity Measurements

Table	A-1				
Pulse	Velocity	Measurements	from	North	Seawall

	Location	Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N2	0.08 (0.25)	297	1.334 (4.375)	4490 (14731)
	1.52 (5.00)	292	1.334 (4.375)	4567 (14983)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	292	1.334 (4.375)	4567 (14983)
	5.94 (19.50)	315	1.334 (4.375)	4233 (13889)
N3	0.08 (0.25)	289	1.334 (4.375)	4614 (15138)
	1.52 (5.00)	294	1.334 (4.375)	4536 (14881)
	3.05 (10.00)	293	1.334 (4.375)	4551 (14932)
	4.57 (15.00)	289	1.334 (4.375)	4614 (15138)
	6.10 (20.00)	290	1.334 (4.375)	4598 (15086)
N4	0.08 (0.25)	301	1.334 (4.375)	4430 (14535)
	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	300	1.334 (4.375)	4445 (14583)
	4.57 (15.00)	287	1.334 (4.375)	4646 (15244)
	5.94 (19.50)	294	1.334 (4.375)	4536 (14881)
N5	0.08 (0.25)	347	1.334 (4.375)	3843 (12608)
	1.52 (5.00)	307	1.334 (4.375)	4344 (14251)
	3.05 (10.00)	302	1.334 (4.375)	4416 (14487)
	4.57 (15.00)	303	1.334 (4.375)	4401 (14439)
	6.02 (19.75)	304	1.334 (4.375)	4387 (14391)
N6	0.08 (0.25)	457	1.334 (4.375)	2918 (9573)*
	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	296	1.334 (4.375)	4505 (14780)
	4.57 (15.00)	319	1.334 (4.375)	4180 (13715)
	5.94 (19.50)	299	1.334 (4.375)	4460 (14632)
N7	0.08 (0.25)	650	1.334 (4.375)	2052 (6731)*
	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	293	1.334 (4.375)	4551 (14932)
	4.57 (15.00)	294	1.334 (4.375)	4536 (14881)
	6.02 (19.75)	296	1.334 (4.375)	4505 (14780)

Table A-1
Pulse Velocity Measurements from North Seawall

	Location	Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N8	0.08 (0.25)	313	1.334 (4.375)	4260 (13978)
	1.52 (5.00)	314	1.334 (4.375)	4247 (13933)
***************	3.05 (10.00)	292	1.334 (4.375)	4567 (14983)
***************************************	4.57 (15.00)	291	1.334 (4.375)	4582 (15034)
••••••••••	6.10 (20.00)	500	1.334 (4.375)	2667 (8750)*
N9	0.08 (0.25)	600	1.334 (4.375)	2223 (7292)*
, , , , , , , , , , , , , , , , , , ,	1.52 (5.00)	296	1.334 (4.375)	4505 (14780)
************	3.05 (10.00)	302	1.334 (4.375)	4416 (14487)
	4.57 (15.00)	302	1.334 (4.375)	4416 (14487)
	6.10 (20.00)	462	1.334 (4.375)	2886 (9470)*
N10	0.08 (0.25)	delam.	1.334 (4.375)	ERR*
	1.52 (5.00)	300	1.334 (4.375)	4445 (14583)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	296	1.334 (4.375)	4505 (14780)
	6.10 (20.00)	delam.	1.334 (4.375)	ERR*
N11	0.08 (0.25)	delam.	1.334 (4.375)	ERR*
	1.52 (5.00)	290	1.334 (4.375)	4598 (15086)
	3.05 (10.00)	289	1.334 (4.375)	4614 (15138)
	4.57 (15.00)	287	1.334 (4.375)	4646 (15244)
	5.94 (19.50)	delam.	1.334 (4.375)	ERR*
N12	0.08 (0.25)	500	1.334 (4.375)	2667 (8750)*
	1.52 (5.00)	293	1.334 (4.375)	4551 (14932)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	292	1.334 (4.375)	4567 (14983)
	6.10 (20.00)	293	1.334 (4.375)	4551 (14932)
N13	0.08 (0.25)	322	1.334 (4.375)	4141 (13587)
	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	299	1.334 (4.375)	4460 (14632)
	4.57 (15.00)	298	1.334 (4.375)	4475 (14681)
	5.94 (19.50)	297	1.334 (4.375)	4490 (14731)

Table A-1			
Pulse Velocity	Measurements	from Nort	h Seawall

	Location	Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N14	0.08 (0.25)	472	1.334 (4.375)	2825 (9269)*
904 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.52 (5.00)	290	1.334 (4.375)	4598 (15086)
	3.05 (10.00)	290	1.334 (4.375)	4598 (15086)
100 177 000 0000 101 101 101 101 101	4.57 (15.00)	311	1.334 (4.375)	4288 (14068)
	6.10 (20.00)	560	1.334 (4.375)	2381 (7813)*
N15	0.08 (0.25)	331	1.334 (4.375)	4029 (13218)
***********	1.52 (5.00)	305	1.334 (4.375)	4372 (14344)
	3.05 (10.00)	301	1.334 (4.375)	4430 (14535)
	4.57 (15.00)	307	1.334 (4.375)	4344 (14251)
	6.02 (19.75)	302	1.334 (4.375)	4416 (14487)
N16	0.08 (0.25)	309	1.334 (4.375)	4316 (14159)
	1.52 (5.00)	313	1.334 (4.375)	4260 (13978)
**********************	3.05 (10.00)	309	1.334 (4.375)	4316 (14159)
	4.57 (15.00)	334	1.334 (4.375)	3993 (13099)
	6.02 (19.75)	310	1.334 (4.375)	4302 (14113)
N17	0.08 (0.25)	300	1.334 (4.375)	4445 (14583)
40200000001150066000000	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	297	1.334 (4.375)	4490 (14731)
	6.10 (20.00)	290	1.334 (4.375)	4598 (15086)
N18	0.08 (0.25)	670	1.334 (4.375)	1990 (6530)*
	1.52 (5.00)	275	1.334 (4.375)	4849 (15909)
	3.05 (10.00)	290	1.334 (4.375)	4598 (15086)
	4.57 (15.00)	288	1.334 (4.375)	4630 (15191)
	6.10 (20.00)	287	1.334 (4.375)	4646 (15244)
	7.62 (25.00)	285	1.334 (4.375)	4679 (15351)
***************************************	9.45 (31.00)	292	1.334 (4.375)	4 567 (14983)
200 000 000 000 000 000 000 000 000 000	10.67 (35.00)	300	1.334 (4.375)	4445 (14583)
	12.19 (40.00)	300	1.334 (4.375)	4445 (14583)
	14.63 (48.00)	296	1.334 (4.375)	

Table A-1
Pulse Velocity Measurements from North Seawall

	Location	Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N19	0.08 (0.25)	293	1.334 (4.375)	4551 (14932)
	1.52 (5.00)	292	1.334 (4.375)	4567 (14983)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	293	1.334 (4.375)	4551 (14932)
	6.10 (20.00)	296	1.334 (4.375)	4505 (14780)
	7.62 (25.00)	301	1.334 (4.375)	4430 (14535)
	9.14 (30.00)	296	1.334 (4.375)	4505 (14780)
	10.67 (35.00)	301	1.334 (4.375)	4430 (14535)
	12.19 (40.00)	315	1.334 (4.375)	4233 (13889)
	13.72 (45.00)	292	1.334 (4.375)	4567 (14983)
	14.63 (48.00)	405	1.334 (4.375)	3293 (10802)*
N20	0.08 (0.25)	450	1.334 (4.375)	2963 (9722)*
	1.52 (5.00)	287	1.334 (4.375)	4646 (15244)
	3.05 (10.00)	293	1.334 (4.375)	4551 (14932)
	4.57 (15.00)	296	1.334 (4.375)	4505 (14780)
	6.10 (20.00)	294	1.334 (4.375)	4536 (14881)
	7.62 (25.00)	304	1.334 (4.375)	4387 (14391)
	9.14 (30.00)	293	1.334 (4.375)	4551 (14932)
	10.67 (35.00)	297	1.334 (4.375)	4490 (14731)
	12.19 (40.00)	295	1.334 (4.375)	4520 (14831)
	13.72 (45.00)	298	1.334 (4.375)	4475 (14681)
7777777777	14.63 (48.00)	301	1.334 (4.375)	4430 (14535)
N21	0.08 (0.25)	587	1.334 (4.375)	2272 (7453)*
	1.52 (5.00)	297	1.334 (4.375)	4490 (14731)
MA * * * * * * * * * * * * * * * * * * *	3.05 (10.00)	300	1.334 (4.375)	4445 (14583)
***************************************	4.57 (15.00)	307	1.334 (4.375)	4344 (14251)
	6.10 (20.00)	304	1.334 (4.375)	4387 (14391)
	7.62 (25.00)	292	1.334 (4.375)	4567 (14983)
	9.14 (30.00)	292	1.334 (4.375)	4567 (14983)
	10.67 (35.00)	301	1.334 (4.375)	***************************************

	Location				
Monolith	Distance from East End of Monolith m (ft)	Time of Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)	
N21	12.19 (40.00)	291	1.334 (4.375)	4582 (15034)	
	13.72 (45.00)	295	1.334 (4.375)	4520 (14831)	
	14.55 (47.75)	288	1.334 (4.375)	4630 (15191)	
N22	0.08 (0.25)	delam.	1.334 (4.375)	ERR*	
	1.52 (5.00)	600	1.334 (4.375)	2223 (7292)*	
	3.05 (10.00)	290	1.334 (4.375)	4 598 (15086)	
	4.57 (15.00)	287	1.334 (4.375)	4646 (15244)	
	6.10 (20.00)	290	1.334 (4.375)	4598 (15086)	
	7.62 (25.00)	291	1.334 (4.375)	4582 (15034)	
	9.14 (30.00)	291	1.334 (4.375)	4582 (15034)	
	10.67 (35.00)	315	1.334 (4.375)	4233 (13889)	
	12.19 (40.00)	325	1.334 (4.375)	4103 (13462)	
	13.72 (45.00)	291	1.334 (4.375)	4582 (15034)	
	14.63 (48.00)	286	1.334 (4.375)	4663 (15297)	
N23	0.08 (0.25)	293	1.334 (4.375)	4551 (14932)	
	1.52 (5.00)	300	1.334 (4.375)	4445 (14583)	
***************************************	3.05 (10.00)	302	1.334 (4.375)	4416 (14487)	
9.0000000000000000000000000000000000000	4.57 (15.00)	294	1.334 (4.375)	4536 (14881)	
# # # # # # # # # # # # #	6.10 (20.00)	297	1.334 (4.375)	4490 (14731)	
• • • • • • • • • • • • • • • • • • • •	7.62 (25.00)	298	1.334 (4.375)	4475 (14681)	
	9.14 (30.00)	295	1.334 (4.375)	4520 (14831)	
	10.67 (35.00)	287	1.334 (4.375)	4646 (15244)	
	12.19 (40.00)	290	1.334 (4.375)	4598 (15086)	
	13.72 (45.00)	295	1.334 (4.375)	4520 (14831)	
	14.55 (47.75)	390	1.334 (4.375)	3419 (11218)*	
N24	0.08 (0.25)	293	1.334 (4.375)	4551 (14932)	
	1.52 (5.00)	299	1.334 (4.375)	4460 (14632)	
	3.05 (10.00)	302	1.334 (4.375)	4416 (14487)	
214 2000 000 000 namaar	4.57 (15.00)	349	1.334 (4.375)	3821 (12536)	
	6.10 (20.00)	306	1.334 (4.375)	4358 (14297)	

Table A-1
Pulse Velocity Measurements from North Seawall

	Location	Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N24	7.62 (25.00)	504	1.334 (4.375)	2646 (8681)*
***************************************	9.14 (30.00)	304	1.334 (4.375)	4387 (14391)
	10.67 (35.00)	315	1.334 (4.375)	4233 (13889)
	12.19 (40.00)	300	1.334 (4.375)	4445 (14583)
	13.72 (45.00)	298	1.334 (4.375)	4475 (14681)
	14.63 (48.00)	287	1.334 (4.375)	4646 (15244)
N25	0.08 (0.25)	279	1.334 (4.375)	4780 (15681)
	1.52 (5.00)	287	1.334 (4.375)	4646 (15244)
	3.05 (10.00)	305	1.334 (4.375)	4372 (14344)
	4.57 (15.00)	297	1.334 (4.375)	4490 (14731)
	6.10 (20.00)	298	1.334 (4.375)	4475 (14681)
	7.62 (25.00)	296	1.334 (4.375)	4505 (14780)
) 900 J 10 0000 pao 140 555 051	9.14 (30.00)	305	1.334 (4.375)	4372 (14344)
	10.67 (35.00)	291	1.334 (4.375)	4582 (15034)
	12.19 (40.00)	295	1.334 (4.375)	4520 (14831)
1 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	13.72 (45.00)	306	1.334 (4.375)	4358 (14297)
	14.94 (49.00)	296	1.334 (4.375)	4505 (14780)
N26	0.08 (0.25)	310	1.334 (4.375)	4302 (14113)
	1.52 (5.00)	301	1.334 (4.375)	4430 (14535)
	3.05 (10.00)	301	1.334 (4.375)	4430 (14535)
	4.57 (15.00)	303	1.334 (4.375)	4401 (14439)
	6.10 (20.00)	304	1.334 (4.375)	4387 (14391)
	7.62 (25.00)	303	1.334 (4.375)	4401 (14439)
	9.14 (30.00)	305	1.334 (4.375)	4372 (14344)
	10.67 (35.00)	309	1.334 (4.375)	4316 (14159)
000 000 000 000 000 000 000	12.19 (40.00)	307	1.334 (4.375)	4344 (14251)
	13.72 (45.00)	305	1.334 (4.375)	4372 (14344)
	14.63 (48.00)	305	1.334 (4.375)	4372 (14344)
N27	0.08 (0.25)	400	1.334 (4.375)	3334 (10938)*
	1.52 (5.00)	302	1.334 (4.375)	4416 (14487)

Table	A-1				
Pulse	Velocity	Measurements	from	North	Seawall

	Location	Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N27	3.05 (10.00)	300	1.334 (4.375)	4445 (14583)
	4.57 (15.00)	320	1.334 (4.375)	4167 (13672)
	6.10 (20.00)	306	1.334 (4.375)	4358 (14297)
	7.62 (25.00)	305	1.334 (4.375)	4372 (14344)
	9.14 (30.00)	307	1.334 (4.375)	4344 (14251)
	10.67 (35.00)	304	1.334 (4.375)	4387 (14391)
	12.19 (40.00)	298	1.334 (4.375)	4475 (14681)
	13.72 (45.00)	296	1.334 (4.375)	4505 (14780)
	14.63 (48.00)	294	1.334 (4.375)	4536 (14881)
N28	0.08 (0.25)	302	1.334 (4.375)	4416 (14487)
	1.52 (5.00)	308	1.334 (4.375)	4330 (14205)
	3.05 (10.00)	310	1.334 (4.375)	4302 (14113)
	4.57 (15.00)	307	1.334 (4.375)	4344 (14251)
	6.10 (20.00)	308	1.334 (4.375)	4330 (14205)
	7.62 (25.00)	293	1.334 (4.375)	4551 (14932)
	9.14 (30.00)	301	1.334 (4.375)	4430 (14535)
	10.67 (35.00)	301	1.334 (4.375)	4430 (14535)
	12.19 (40.00)	303	1.334 (4.375)	4401 (14439)
	13.72 (45.00)	301	1.334 (4.375)	4430 (14535)
	14.63 (48.00)	297	1.334 (4.375)	4490 (14731)
N29	0.08 (0.25)	600	1.334 (4.375)	2223 (7292)*
	1.52 (5.00)	293	1.334 (4.375)	4551 (14932)
	3.05 (10.00)	296	1.334 (4.375)	4505 (14780)
	4.57 (15.00)	301	1.334 (4.375)	4430 (14535)
	6.10 (20.00)	306	1.334 (4.375)	4358 (14297)
	7.62 (25.00)	305	1.334 (4.375)	4372 (14344)
	9.14 (30.00)	303	1.334 (4.375)	4401 (14439)
	10.67 (35.00)	334	1.334 (4.375)	3993 (13099)
	12.19 (40.00)	339	1.334 (4.375)	3934 (12906)
	13.72 (45.00)	334	1.334 (4.375)	3993 (13099)
Low Measurer	ment			

Table A-1
Pulse Velocity Measurements from North Seawall

	Location	77		
Monolith	Distance from East End of Monolith m (ft)	Time of Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N29	14.63 (48.00)	291	1.334 (4.375)	4582 (15034)
N30	0.08 (0.25)	292	1.334 (4.375)	4567 (14983)
	1.52 (5.00)	303	1.334 (4.375)	4401 (14439)
	3.05 (10.00)	303	1.334 (4.375)	4401 (14439)
	4.57 (15.00)	303	1.334 (4.375)	4401 (14439)
	6.10 (20.00)	289	1.334 (4.375)	4614 (15138)
	7.62 (25.00)	292	1.334 (4.375)	4567 (14983)
	9.14 (30.00)	304	1.334 (4.375)	4387 (14391)
	10.67 (35.00)	298	1.334 (4.375)	4475 (14681)
	12.19 (40.00)	302	1.334 (4.375)	4416 (14487)
	13.72 (45.00)	299	1.334 (4.375)	4460 (14632)
	14.63 (48.00)	295	1.334 (4.375)	4520 (14831)
N31	0.08 (0.25)	410	1.334 (4.375)	3252 (10671)*
	1.52 (5.00)	291	1.334 (4.375)	4582 (15034)
	3.05 (10.00)	299	1.334 (4.375)	4460 (14632)
	4.57 (15.00)	297	1.334 (4.375)	4490 (14731)
	6.10 (20.00)	289	1.334 (4.375)	4614 (15138)
	7.62 (25.00)	292	1.334 (4.375)	4567 (14983)
	9.14 (30.00)	350	1.334 (4.375)	3810 (12500)
	10.67 (35.00)	293	1.334 (4.375)	4551 (14932)
	12.19 (40.00)	297	1.334 (4.375)	4490 (14731)
	13.72 (45.00)	295	1.334 (4.375)	4520 (14831)
	14.63 (48.00)	700	1.334 (4.375)	1905 (6250)*
N32	0.08 (0.25)	295	1.334 (4.375)	4520 (14831)
	1.52 (5.00)	299	1.334 (4.375)	4460 (14632)
9 994 994 994 44 60 Managase 204	3.05 (10.00)	296	1.334 (4.375)	4505 (14780)
	4.57 (15.00)	299	1.334 (4.375)	4460 (14632)
	6.10 (20.00)	300	1.334 (4.375)	4445 (14583)
· · · · · · · · · · · · · · · · · · ·	7.62 (25.00)	303	1.334 (4.375)	4401 (14439)
TOOL GOOD GOOD GOOD GOVE GOVE GOVE	9.14 (30.00)	305	1.334 (4.375)	4372 (14344)
Low Measure	ement			

Location				
Monolith	Distance from East End of Monolith m (ft)	Time of Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N32	10.67 (35.00)	330	1.334 (4.375)	4041 (13258)
	12.19 (40.00)	307	1.334 (4.375)	4344 (14251)
	13.72 (45.00)	302	1.334 (4.375)	4416 (14487)
	14.63 (48.00)	306	1.334 (4.375)	4358 (14297)
N33	0.08 (0.25)	287	1.334 (4.375)	4646 (15244)
*********************	1.52 (5.00)	290	1.334 (4.375)	4598 (15086)
7.011 MI 0700 000 000 000 000	3.05 (10.00)	290	1.334 (4.375)	4598 (15086)
	4.57 (15.00)	333	1.334 (4.375)	4005 (13138)
***************************************	6.10 (20.00)	583	1.334 (4.375)	2287 (7504)*
*******************	7.62 (25.00)	293	1.334 (4.375)	4551 (14932)
	9.14 (30.00)	303	1.334 (4.375)	4401 (14439)
	10.67 (35.00)	297	1.334 (4.375)	4490 (14731)
	12.19 (40.00)	290	1.334 (4.375)	4598 (15086)
	13.72 (45.00)	293	1.334 (4.375)	4551 (14932)
	14.63 (48.00)	310	1.334 (4.375)	4302 (14113)
N34	0.08 (0.25)	296	1.334 (4.375)	4505 (14780)
	1.52 (5.00)	298	1.334 (4.375)	4475 (14681)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	291	1.334 (4.375)	4582 (15034)
	6.10 (20.00)	288	1.334 (4.375)	4630 (15191)
	7.62 (25.00)	299	1.334 (4.375)	4460 (14632)
	9.14 (30.00)	293	1.334 (4.375)	4551 (14932)
	10.67 (35.00)	297	1.334 (4.375)	4490 (14731)
	12.19 (40.00)	298	1.334 (4.375)	4475 (14681)
	13.72 (45.00)	293	1.334 (4.375)	4551 (14932)
	14.86 (48.75)	292	1.334 (4.375)	4567 (14983)
N35	0.08 (0.25)	292	1.334 (4.375)	4567 (14983)
	1.52 (5.00)	288	1.334 (4.375)	4630 (15191)
	3.05 (10.00)	285	1.334 (4.375)	4679 (15351)
	4.57 (15.00)	288	1.334 (4.375)	4630 (15191)

Table A-1
Pulse Velocity Measurements from North Seawall

Location		Time of		
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N35	6.10 (20.00)	295	1.334 (4.375)	4520 (14831)
	7.62 (25.00)	297	1.334 (4.375)	4490 (14731)
	9.14 (30.00)	300	1.334 (4.375)	4445 (14583)
***************************************	10.67 (35.00)	295	1.334 (4.375)	4520 (14831)
**************************************	. 12.19 (40.00)	289	1.334 (4.375)	4614 (15138)
I PT 1144 1144 1143 1144 1144 1144 1144 114	13.72 (45.00)	290	1.334 (4.375)	4598 (15086)
**************************************	14.63 (48.00)	296	1.334 (4.375)	4505 (14780)
N36	0.08 (0.25)	293	1.334 (4.375)	4551 (14932)
**************	1.52 (5.00)	291	1.334 (4.375)	4582 (15034)
**********************	3.05 (10.00)	291	1.334 (4.375)	4582 (15034)
100 000 100 001 000 0 00 0 00 000 000 000 000 000 000	4.57 (15.00)	286	1.334 (4.375)	4663 (15297)
***************************************	6.10 (20.00)	285	1.334 (4.375)	4679 (15351)
Meet 000 44 000 4 000 000 000 000 000	7.62 (25.00)	282	1.334 (4.375)	4729 (15514)
	9.14 (30.00)	287	1.334 (4.375)	4646 (15244)
	10.67 (35.00)	292	1.334 (4.375)	4567 (14983)
	12.19 (40.00)	293	1.334 (4.375)	4551 (14932)
***************************************	13.72 (45.00)	297	1.334 (4.375)	4490 (14731)
	14.78 (48.50)	289	1.334 (4.375)	4614 (15138)
N37	0.08 (0.25)	305	1.334 (4.375)	4372 (14344)
*******************	1.52 (5.00)	302	1.334 (4.375)	4416 (14487)
	3.05 (10.00)	308	1.334 (4.375)	4330 (14205)
	4.57 (15.00)	302	1.334 (4.375)	4416 (14487)
	6.10 (20.00)	302	1.334 (4.375)	4416 (14487)
	7.62 (25.00)	301	1.334 (4.375)	4430 (14535)
44 7 44 5 54 4 44 4 114 91 90 4 <u>90 4</u> 90 90 90	9.14 (30.00)	310	1.334 (4.375)	4302 (14113)
9 6 F 11 11 16 11 16 1 16 1 1 1 1 1 1 1 1	10.67 (35.00)	310	1.334 (4.375)	4302 (14113)
100 000 000 000 000 0000 000 1111 1111	12.19 (40.00)	303	1.334 (4.375)	4401 (14439)
7 0 4 640 844 864 6411 464 866 666 66	13.72 (45.00)	304	1.334 (4.375)	4387 (14391)
5 90 9 9 4 9 4 5 5 4 9 9 4 5 5 5 7 4 7 4 7 4 7 4 7 4 7 4 7 4 7 4	14.63 (48.00)	296	1.334 (4.375)	4505 (14780)
	0.08 (0.25)	525	1.334 (4.375)	2540 (8333)*

Table .	A-1				
Pulse '	Velocity	Measurements	from	North	Seawall

	Location	Time of	·	
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N38	1.52 (5.00)	291	1.334 (4.375)	4582 (15034)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	298	1.334 (4.375)	4475 (14681)
	6.10 (20.00)	293	1.334 (4.375)	4551 (14932)
	7.62 (25.00)	296	1.334 (4.375)	4505 (14780)
	9.14 (30.00)	295	1.334 (4.375)	4520 (14831)
	10.67 (35.00)	301	1.334 (4.375)	4430 (14535)
	12.19 (40.00)	301	1.334 (4.375)	4430 (14535)
	13.72 (45.00)	296	1.334 (4.375)	4505 (14780)
	14.63 (48.00)	302	1.334 (4.375)	4416 (14487)
N39	0.08 (0.25)	307	1.334 (4.375)	4344 (14251)
	1.52 (5.00)	301	1.334 (4.375)	4430 (14535)
	3.05 (10.00)	307	1.334 (4.375)	4344 (14251)
	4.57 (15.00)	301	1.334 (4.375)	4430 (14535)
	6.10 (20.00)	292	1.334 (4.375)	4567 (14983)
	7.62 (25.00)	294	1.334 (4.375)	4536 (14881)
	9.14 (30.00)	297	1.334 (4.375)	4490 (14731)
	10.67 (35.00)	288	1.334 (4.375)	4630 (15191)
	12.19 (40.00)	289	1.334 (4.375)	4614 (15138)
	13.72 (45.00)	289	1.334 (4.375)	4614 (15138)
	14.63 (48.00)	297	1.334 (4.375)	4490 (14731)
N40	0.08 (0.25)	290	1.334 (4.375)	4598 (15086)
PU 000 000 0000 000 000 000 000	1.52 (5.00)	300	1.334 (4.375)	4445 (14583)
***************************************	3.05 (10.00)	298	1.334 (4.375)	4475 (14681)
	4.57 (15.00)	300	1.334 (4.375)	4445 (14583)
	6.10 (20.00)	. 300	1.334 (4.375)	4445 (14583)
	7.62 (25.00)	297	1.334 (4.375)	4490 (14731)
	9.14 (30.00)	294	1.334 (4.375)	4536 (14881)
	10.67 (35.00)	300	1.334 (4.375)	4445 (14583)
	12.19 (40.00)	308	1.334 (4.375)	4330 (14205)
Low Measure	ment			

Table A-1
Pulse Velocity Measurements from North Seawall

	Location	Time of		
M onolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N40	13.72 (45.00)	307	1.334 (4.375)	4344 (14251)
***************************************	14.78 (48.50)	297	1.334 (4.375)	4490 (14731)
N41	0.08 (0.25)	287	1.334 (4.375)	4646 (15244)
	1.52 (5.00)	292	1.334 (4.375)	4567 (14983)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	292	1.334 (4.375)	4567 (14983)
	6.10 (20.00)	297	1.334 (4.375)	4490 (14731)
	7.62 (25.00)	300	1.334 (4.375)	4445 (14583)
	9.14 (30.00)	364	1.334 (4.375)	3663 (12019)
	10.67 (35.00)	299	1.334 (4.375)	4460 (14632)
	12.19 (40.00)	297	1.334 (4.375)	4490 (14731)
,	13.72 (45.00)	297	1.334 (4.375)	4490 (14731)
	15.09 (49.50)	292	1.334 (4.375)	4567 (14983)
N42	0.08 (0.25)	284	1.334 (4.375)	4695 (15405)
	1.52 (5.00)	287	1.334 (4.375)	4646 (15244)
	3.05 (10.00)	292	1.334 (4.375)	4567 (14983)
	4.57 (15.00)	299	1.334 (4.375)	4460 (14632)
N43	0.08 (0.25)	297	1.334 (4.375)	4490 (14731)
	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	291	1.334 (4.375)	4582 (15034)
	4.57 (15.00)	296	1.334 (4.375)	4505 (14780)
N44	0.08 (0.25)	306	1.334 (4.375)	4358 (14297)
	1.52 (5.00)	294	1.334 (4.375)	4536 (14881)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	320	1.334 (4.375)	4167 (13672)
	6.10 (20.00)	300	1.334 (4.375)	4445 (14583)
	7.16 (23.50)	303	1.334 (4.375)	4401 (14439)
N45	0.08 (0.25)	293	1.334 (4.375)	4551 (14932)
	1.52 (5.00)	293	1.334 (4.375)	4551 (14932)
	3.05 (10.00)	296	1.334 (4.375)	4505 (14780)

Table A-1				
Pulse Velocity	Measurements	from	North	Seawall

	Location	Time of		•
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N45	5.18 (17.00)	293	1.334 (4.375)	4551 (14932)
	5.79 (19.00)	297	1.334 (4.375)	4490 (14731)
N46	0.08 (0.25)	299	1.334 (4.375)	4460 (14632)
	1.52 (5.00)	295	1.334 (4.375)	4520 (14831)
	3.05 (10.00)	294	1.334 (4.375)	4536 (14881)
	4.57 (15.00)	295	1.334 (4.375)	4520 (14831)
	5.79 (19.00)	310	1.334 (4.375)	4302 (14113)
N47	0.08 (0.25)	296	1.334 (4.375)	4505 (14780)
	1.52 (5.00)	296	1.334 (4.375)	4505 (14780)
	3.05 (10.00)	297	1.334 (4.375)	4490 (14731)
	4.57 (15.00)	304	1.334 (4.375)	4387 (14391)
	5.79 (19.00)	304	1.334 (4.375)	4387 (14391)
N48	0.08 (0.25)	317	1.334 (4.375)	4207 (13801)
	1.52 (5.00)	309	1.334 (4.375)	4316 (14159)
	3.05 (10.00)	309	1.334 (4.375)	4316 (14159)
	4.57 (15.00)	315	1.334 (4.375)	4233 (13889)
	6.10 (20.00)	313	1.334 (4.375)	4260 (13978)
N49	0.08 (0.25)	292	1.334 (4.375)	4567 (14983)
	1.52 (5.00)	294	1.334 (4.375)	4536 (14881)
	3.05 (10.00)	295	1.334 (4.375)	4520 (14831)
	4.57 (15.00)	291	1.334 (4.375)	4582 (15034)
	5.64 (18.50)	294	1.334 (4.375)	4536 (14881)
N50	0.08 (0.25)	302	1.334 (4.375)	4416 (14487)
	1.52 (5.00)	300	1.334 (4.375)	4445 (14583)
	3.05 (10.00)	301	1.334 (4.375)	4430 (14535)
	4.57 (15.00)	295	1.334 (4.375)	4520 (14831)
	5.64 (18.50)	302	1.334 (4.375)	4416 (14487)
N51	0.08 (0.25)	296	1.334 (4.375)	4505 (14780)
	1.52 (5.00)	299	1.334 (4.375)	4460 (14632)
	3.05 (10.00)	296	1.334 (4.375)	4505 (14780)

Table A-1
Pulse Velocity Measurements from North Seawall

	Location	Time of	·	
Monolith	Distance from East End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N51	4.57 (15.00)	295	1.334 (4.375)	4520 (14831)
	5.72 (18.75)	295	1.334 (4.375)	4520 (14831)
N52	0.08 (0.25)	307	1.334 (4.375)	4344 (14251)
	1.52 (5.00)	303	1.334 (4.375)	4401 (14439)
*** *** *** *** *** *** *** *** *** **	3.05 (10.00)	301	1.334 (4.375)	4430 (14535)
****	4.57 (15.00)	300	1.334 (4.375)	4445 (14583)
	5.79 (19.00)	297	1.334 (4.375)	4490 (14731)
N53	0.08 (0.25)	297	1.334 (4.375)	4490 (14731)
10 100 me (el erde les eccèses s	1.52 (5.00)	293	1.334 (4.375)	4551 (14932)
101000000000000000000000000000000000000	3.05 (10.00)	310	1.334 (4.375)	4302 (14113)
M 1000000 200000000000000000000000000000	4.57 (15.00)	295	1.334 (4.375)	4520 (14831)
	5.79 (19.00)	293	1.334 (4.375)	4551 (14932)
N54	0.08 (0.25)	306	1.334 (4.375)	4358 (14297)
**************	1.52 (5.00)	. 307	1.334 (4.375)	4344 (14251)
************************	3.05 (10.00)	308	1.334 (4.375)	4330 (14205)
4 440 440 400 400 400 400 400 400 400	4.57 (15.00)	305	1.334 (4.375)	4372 (14344)
	5.64 (18.50)	296	1.334 (4.375)	4505 (14780)
N55	0.08 (0.25)	296	1.334 (4.375)	4505 (14780)
10000403080004033040000044	· 1.52 (5.00)	296	1.334 (4.375)	4505 (14780)
	3.05 (10.00)	301	1.334 (4.375)	4430 (14535)
	4.57 (15.00)	294	1.334 (4.375)	4536 (14881)
	5.18 (17.00)	294	1.334 (4.375)	4536 (14881)
N56	0.08 (0.25)	307	1.334 (4.375)	4344 (14251)
	1.52 (5.00)	300	1.334 (4.375)	4445 (14583)
	3.05 (10.00)	306	1.334 (4.375)	4358 (14297)
**********************	4.57 (15.00)	307	1.334 (4.375)	4344 (14251)
	4.88 (16.00)	304	1.334 (4.375)	4387 (14391)
N57	0.08 (0.25)	315	1.334 (4.375)	4233 (13889)
	1.52 (5.00)	294	1.334 (4.375)	4536 (14881)
	3.05 (10.00)	294	1.334 (4.375)	4536 (14881)
Low Measuren	nent			

	Location			
Monolith	Distance from East End of Monolith m (ft)	Time of Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
N57	4.57 (15.00)	302	1.334 (4.375)	4416 (14487)
	6.10 (20.00)	300	1.334 (4.375)	4445 (14583)
	6.40 (21.00)	299	1.334 (4.375)	4460 (14632)
N58	0.08 (0.25)	305	1.334 (4.375)	4372 (14344)
048 5 0.0 5 0 0 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1.52 (5.00)	290	1.334 (4.375)	4598 (15086)
	3.05 (10.00)	352	1.334 (4.375)	3788 (12429)
	4.57 (15.00)	295	1.334 (4.375)	4520 (14831)
	6.10 (20.00)	292	1.334 (4.375)	4567 (14983)
	6.55 (21.50)	299	1.334 (4.375)	4460 (14632)
N59	0.08 (0.25)	315	1.334 (4.375)	4233 (13889)
200000000000000000000000000000000000000	1.52 (5.00)	288	1.334 (4.375)	4630 (15191)
	3.05 (10.00)	288	1.334 (4.375)	4630 (15191)
	4.57 (15.00)	298	1.334 (4.375)	4475 (14681)
	6.10 (20.00)	660	1.334 (4.375)	2020 (6629)*
N60	0.08 (0.25)	spalled	1.334 (4.375)	ERR*
1471 8000 400 pasanana	1.52 (5.00)	spalled	1.334 (4.375)	ERR*
P10 0000 000 000	3.05 (10.00)	299	1.334 (4.375)	4460 (14632)
900000000000000000000000000000000000000	4.57 (15.00)	302	1.334 (4.375)	4416 (14487)
	6.10 (20.00)	292	1.334 (4.375)	4567 (14983)
	7.62 (25.00)	291	1.334 (4.375)	4582 (15034)

Table A-2
Pulse Velocity Measurements from South Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S1	0.08 (0.25)	142	0.622 (2.040)	4382 (14378)
004 000 004 104 4 0 04 0 00 000 00	1.52 (5.00)	143	0.622 (2.040)	4352 (14278)
\$94 C 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3.05 (10.00)	144	0.622 (2.040)	4322 (14178)
200 D00 D44 D00D D04 440 D00 004	4.57 (15.00)	142	0.622 (2.040)	4382 (14378)
448 482 884 884 984 8 84 484 444	6.02 (19.75)	326	0.622 (2.040)	1909 (6263)*1
S2	0.08 (0.25)	167	0.622 (2.040)	3726 (12226)
*** ***	1.52 (5.00)	168	0.622 (2.040)	3704 (12153)
••••••••••••••••••••••••••••••••••••••	3.05 (10.00)	162	0.622 (2.040)	3841 (12603)
	4.57 (15.00)	158	0.622 (2.040)	3939 (12922)
***********************	6.10 (20.00)	163	0.622 (2.040)	3818 (12526)
S3	0.08 (0.25)	156	0.622 (2.040)	3989 (13088)
*** *** *** *** *** *** ***	1.52 (5.00)	145	0.622 (2.040)	4292 (14081)
*************************	3.05 (10.00)	140	0.622 (2.040)	4445 (14584)
*****************************	4.57 (15.00)	150	0.622 (2.040)	4149 (13611)
*** *** *** *** *** *** ***	6.10 (20.00)	162	0.622 (2.040)	3841 (12603)
S4	0.08 (0.25)	150	0.622 (2.040)	4149 (13611)
	1.52 (5.00)	149	0.622 (2.040)	4177 (13703)
	3.05 (10.00)	150	0.622 (2.040)	4149 (13611)
000 100 000 00 10 000 00 1 0 0 0 090	4.57 (15.00)	147	0.622 (2.040)	4233 (13889)
	6.32 (20.75)	150	0.622 (2.040)	4149 (13611)
S5	0.08 (0.25)	152	0.622 (2.040)	4094 (13432)
***************************************	1.52 (5.00)	147	0.622 (2.040)	4233 (13889)
	3.05 (10.00)	148	0.622 (2.040)	4205 (13795)
	4.57 (15.00)	149	0.622 (2.040)	4177 (13703)
	5.79 (19.00)	140	0.622 (2.040)	4445 (14584)
S6	0.08 (0.25)	140	0.622 (2.040)	4445 (14584)
	1.52 (5.00)	146	0.622 (2.040)	4262 (13984)
	3.05 (10.00)	146	0.622 (2.040)	4262 (13984)
. 200 204 004 004 004 204 204 004	4.57 (15.00)	147	0.622 (2.040)	4233 (13889)
. 444 000 544 6464 554 644 554 654	6.10 (20.00)	148	0.622 (2.040)	4205 (13795)

Table A-2 Pulse Velocity Measurements from South Seawall Location Time of Path Length Pulse Velocity Distance from West Arrival m (ft) m/s (ft/s) Monolith End of Monolith microseconds m (ft) **S6** 6.32 (20.75) 144 0.622 (2.040) 4322 (14178) **S7** 0.08 (0.25) 188 0.622 (2.040) 3310 (10860)*1 1.52 (5.00) 189 0.622 (2.040) 3293 (10803)*1 3.05 (10.00) 151 0.622 (2.040) 4121 (13521)³ 4.57 (15.00) 143 0.622 (2.040) 4352 (14278)3 6.10 (20.00) 163 0.622 (2.040) 3818 (12526)³ 0.08 (0.25) 150 0.622 (2.040) 4149 (13611) 1.52 (5.00) 145 0.622 (2.040) 4292 (14081) 3.05 (10.00) 144 0.622 (2.040) 4322 (14178) 4.57 (15.00) 149 0.622 (2.040) 4177 (13703) 6.10 (20.00) 148 0.622 (2.040) 4205 (13795) 6.63 (21.75) 148 0.622 (2.040) 4205 (13795) 0.08(0.25)145 0.622 (2.040) 4292 (14081) 1.52 (5.00) 144 0.622 (2.040) 4322 (14178) 3.05 (10.00) 142 0.622 (2.040) 4382 (14378) 4.57 (15.00) 141 0.622 (2.040) 4414 (14480) 6.10 (20.00) 141 0.622 (2.040) 4414 (14480) 6.40 (21.00) 138 0.622 (2.040) 4509 (14795) 0.08 (0.25) 139 0.622 (2.040) 4477 (14688) 1.52 (5.00) 141 0.622 (2.040) 4414 (14480) 3.05 (10.00) 152 0.622 (2.040) 4094 (13432) 3.96 (13.00) 144 0.622 (2.040) 4322 (14178) 4.57 (15.00) 173 0.800 (2.625) 4625 (15173) 6.10 (20.00) 180 0.800 (2.625) 4445 (14583) 0.08(0.25)178 0.800 (2.625) 4495 (14747) 1.52 (5.00) 168 0.800 (2.625) 4763 (15625) 3.05 (10.00) 174 0.800 (2.625) 4598 (15086) 4.57 (15.00) 172 0.800 (2.625) 4652 (15262) 6.10 (20.00) 178 0.800 (2.625) 4495 (14747) 6.40 (21.00) 206 0.800 (2.625) 3884 (12743) *Low Measurement ¹Spalled ² Edge Delamination 3 Cracked

Table A-2
Pulse Velocity Measurements from South Seawall

l	ocation	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S12	0.08 (0.25)	185	0.800 (2.625)	4325 (14189)
	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
	3.05 (10.00)	173	0.800 (2.625)	4625 (15173)
	4.57 (15.00)	169	0.800 (2.625)	4734 (15533)
	5.79 (19.00)	244	0.800 (2.625)	3279 (10758)
S13	0.08 (0.25)	178	0.800 (2.625)	4495 (14747)
95#9 00 940 940 940 990 000 1 9 0 0 144 14 00 0000	1.52 (5.00)	179	0.800 (2.625)	4470 (14665)
100 000 000 001 000 000 000 noog p q 6 g d	3.05 (10.00)	187	0.800 (2.625)	4279 (14037)
***************************************	4.57 (15.00)	181	0.800 (2.625)	4420 (14503)
PRE 1999 999 999 999 999 999 999 999 999 9	6.10 (20.00)	178	0.800 (2.625)	4495 (14747)
S14	0.08 (0.25)	176	0.800 (2.625)	4546 (14915)
***************************************	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
**************************************	3.05 (10.00)	174	0.800 (2.625)	4598 (15086)
	4.57 (15.00)	172	0.800 (2.625)	4652 (15262)
91 414 104 114 4 90 900 900 900 114 617 14 e 940 0	5.72 (18.75)	172	0.800 (2.625)	4652 (15262)
S15	0.08 (0.25)	173	0.800 (2.625)	4625 (15173)
***************************************	1.52 (5.00)	166	0.800 (2.625)	4820 (15813)
	3.05 (10.00)	165	0.800 (2.625)	4849 (15909)
	4.57 (15.00)	168	0.800 (2.625)	4763 (15625)
	5.72 (18.75)	167	0.800 (2.625)	4791 (15719)
S16	0.08 (0.25)	spall	0.800 (2.625)	ERR *2
······································	1.52 (5.00)	276	0.800 (2.625)	2899 (9511)*1
	3.05 (10.00)	357	0.800 (2.625)	2241 (7353)* ¹
***************************************	4.57 (15.00)	396	0.800 (2.625)	2020 (6629)*1
	6.10 (20.00)	397	0.800 (2.625)	2015 (6612)*1
***************************************	6.55 (21.50)	200	0.800 (2.625)	4001 (13125)
S17	0.08 (0.25)	180	0.800 (2.625)	4445 (14583)
	1.52 (5.00)	179	0.800 (2.625)	4470 (14665)
***************************************	3.05 (10.00)	182	0.800 (2.625)	4396 (14423) ¹
	4.57 (15.00)	spali	0.800 (2.625)	ERR *12
*Low Measurem	ent ¹ S	palled	² Edge Delamination	³ Crack

Table A-2
Pulse Velocity Measurements from South Seawall

1	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S17	5.64 (18.50)	spall	0.800 (2.625)	ERR®2
S18	0.08 (0.25)	177	0.800 (2.625)	4520 (14831)
	1.52 (5.00)	250	0.800 (2.625)	3200 (10500)* ³
***************************************	3.05 (10.00)	167	0.800 (2.625)	4791 (15719)
988747888888888	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
	6.10 (20.00)	550	0.800 (2.625)	1455 (4773)* ¹
	6.40 (21.00)	192	0.800 (2.625)	4167 (13672) ¹
S19	0.08 (0.25)	171	0.800 (2.625)	4679 (15351)
	1.52 (5.00)	171	0.800 (2.625)	4679 (15351)
***************************************	3.05 (10.00)	172	0.800 (2.625)	4652 (15262)
	4.57 (15.00)	175	0.800 (2.625)	4572 (15000)
	5.79 (19.00)	171	0.800 (2.625)	4679 (15351)
S20	0.08 (0.25)	spalled	0.800 (2.625)	ERR*
	1.52 (5.00)	spalled	0.800 (2.625)	ERR*
	3.05 (10.00)	spalled	0.800 (2.625)	**************************************
	4.57 (15.00)	spalled	0.800 (2.625)	ERR*
	6.10 (20.00)	spalled	0.800 (2.625)	ERR*
S21	0.08 (0.25)	177	0.800 (2.625)	4520 (14831)
	1.52 (5.00)	178	0.800 (2.625)	4495 (14747)
	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
	4.57 (15.00)	179	0.800 (2.625)	4470 (14665)
	6.10 (20.00)	180	0.800 (2.625)	4445 (14583)
S22	0.08 (0.25)	181	0.800 (2.625)	4420 (14503)
	1.52 (5.00)	183	0.800 (2.625)	4372 (14344)
	3.05 (10.00)	182	0.800 (2.625)	4396 (14423)
	4.57 (15.00)	184	0.800 (2.625)	4348 (14266)
	6.10 (20.00)	200	0.800 (2.625)	4001 (13125)
S23	0.08 (0.25)	190	0.800 (2.625)	4211 (13816)
	1.52 (5.00)	176	0.800 (2.625)	4546 (14915)
***************************************	3.05 (10.00)	179	0.800 (2.625)	4470 (14665)
*Low Measureme	nt ¹ Sr	Dellac	² Edge Delamin	ation ³ Cracked

Table A-2
Pulse Velocity Measurements from South Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S23	4.57 (15.00)	180	0.800 (2.625)	4445 (14583)
**************************************	6.10 (20.00)	179	0.800 (2.625)	4470 (14665)
S24	0.08 (0.25)	181	0.800 (2.625)	4420 (14503)
****************	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
\$11.0 1990 1990 1990 1990 1990 1990 1990	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
**********************	4.57 (15.00)	177	0.800 (2.625)	4520 (14831)
***************************************	6.10 (20.00)	173	0.800 (2.625)	4625 (15173)
S25	0.08 (0.25)	175	0.800 (2.625)	4572 (15000)
***************************************	1.52 (5.00)	175	0.800 (2.625)	4572 (15000)
***************************************	3.05 (10.00)	178	0.800 (2.625)	4495 (14747)
***************************************	4.88 (16.00)	181	0.800 (2.625)	4420 (14503)
***************************************	6.10 (20.00)	179	0.800 (2.625)	4470 (14665)
S26	0.08 (0.25)	177	0.800 (2.625)	4520 (14831)
***************************************	1.52 (5.00)	176	0.800 (2.625)	4546 (14915)
	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
***************************************	0.08 (0.25)	178	0.800 (2.625)	4495 (14747)
	1.52 (5.00)	179	0.800 (2.625)	4470 (14665)
S27	3.05 (10.00)	174	0.800 (2.625)	4598 (15086)
	4.57 (15.00)	171	0.800 (2.625)	4679 (15351)
	5.79 (19.00)	172	0.800 (2.625)	4652 (15262)
	0.08 (0.25)	170	0.800 (2.625)	4706 (15441)
***************************************	1.52 (5.00)	NR	0.800 (2.625)	ERR*1
S28	3.05 (10.00)	181	0.800 (2.625)	4420 (14503)
	4.57 (15.00)	182	0.800 (2.625)	4396 (14423)
	6.10 (20.00)	184	0.800 (2.625)	4348 (14266)
	0.08 (0.25)	182	0.800 (2.625)	4396 (14423)
***************************************	1.52 (5.00)	184	0.800 (2.625)	4348 (14266)
S29	0.08 (0.25)	185	0.800 (2.625)	4325 (14189)
***************************************	1.52 (5.00)	175	0.800 (2.625)	4572 (15000)
	3.05 (10.00)	240	0.800 (2.625)	3334 (10938)*

Table A-2 Pulse Velocity Measurements from South Seawall Location Time of Path Length **Pulse Velocity** Distance from West Arrival m (ft) m/s (ft/s) Monolith **End of Monolith** microseconds m (ft) S29 4.57 (15.00) 179 0.800 (2.625) 4470 (14665) 6.10 (20.00) 175 0.800 (2.625) 4572 (15000) **S30** 0.08 (0.25) 305 0.800 (2.625) 2623 (8607)*3 1.52 (5.00) 178 0.800 (2.625) 4495 (14747) 3.05 (10.00) 172 0.800 (2.625) 4652 (15262) 4.57 (15.00) 175 0.800 (2.625) 4572 (15000) 6.10 (20.00) 178 0.800 (2.625) 4495 (14747) S31 0.08 (0.25) 173 0.800 (2.625) 4625 (15173) 1.52 (5.00) 172 0.800 (2.625) 4652 (15262) 3.05 (10.00) 173 0.800 (2.625) 4625 (15173) 4.57 (15.00) 173 0.800 (2.625) 4625 (15173) 6.10 (20.00) 470 0.800 (2.625) 1702 (5585)*1 S32 0.08(0.25)176 0.800 (2.625) 4546 (14915) 1.52 (5.00) 170 0.800 (2.625) 4706 (15441) 3.05 (10.00) 170 0.800 (2.625) 4706 (15441) 4.57 (15.00) 172 0.800 (2.625) 4652 (15262) 6.10 (20.00) 184 0.800 (2.625) 4348 (14266) **S33** 0.08 (0.25) 359 0.800 (2.625) 2229 (7312)*3 1.52 (5.00) 173 0.800 (2.625) 4625 (15173) 3.05 (10.00) 171 0.800 (2.625) 4679 (15351) 4.57 (15.00) 173 0.800(2.625)4625 (15173) 6.10 (20.00) 193 0.800 (2.625) 4146 (13601) 0.08(0.25)177 0.800 (2.625) 4520 (14831) 1.52 (5.00) 169 0.800 (2.625) 4734 (15533) 3.05 (10.00) 170 0.800 (2.625) 4706 (15441) 4.57 (15.00) 174 0.800 (2.625) 4598 (15086) 6.10 (20.00) 171 0.800 (2.625) 4679 (15351) **S35** 0.08 (0.25) 177 0.800 (2.625) 4520 (14831) 1.52 (5.00) 166 0.800 (2.625) 4820 (15813) 3.05 (10.00) 163 0.800 (2.625) 4909 (16104)

² Edge Delamination

3 Cracked

¹Spalled

*Low Measurement

Table A-2
Pulse Velocity Measurements from South Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S35	4.88 (16.00)	169	0.800 (2.625)	4734 (15533)
	6.10 (20.00)	179	0.800 (2.625)	4470 (14665)
S36	0.08 (0.25)	179	0.800 (2.625)	4470 (14665)
	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
	3.05 (10.00)	170	0.800 (2.625)	4706 (15441)
	4.57 (15.00)	174	0.800 (2.625)	4598 (15086)
	6.10 (20.00)	175	0.800 (2.625)	4572 (15000)
S37	0.08 (0.25)	176	0.800 (2.625)	4546 (14915)
	1.52 (5.00)	169	0.800 (2.625)	4 734 (15533)
	3.05 (10.00)	167	0.800 (2.625)	4791 (15719)
	4.57 (15.00)	172	0.800 (2.625)	4652 (15262)
	6.10 (20.00)	185	0.800 (2.625)	4325 (14189)
S38	0.08 (0.25)	179	0.800 (2.625)	4470 (14665)
	1.52 (5.00)	172	0.800 (2.625)	4652 (15262)
	3.05 (10.00)	173	0.800 (2.625)	4625 (15173)
	4.57 (15.00)	176	0.800 (2.625)	4546 (14915)
	6.10 (20.00)	179	0.800 (2.625)	4470 (14665)
S39	0.08 (0.25)	181	0.800 (2.625)	4420 (14503)
	1.52 (5.00)	165	0.800 (2.625)	4849 (15909)
	3.05 (10.00)	163	0.800 (2.625)	4909 (16104)
	4.57 (15.00)	168	0.800 (2.625)	4763 (15625)
	5.94 (19.50)	186	0.800 (2.625)	4302 (14113)
S40	0.08 (0.25)	172	0.800 (2.625)	4652 (15262)
400000000000000000000000000000000000000	1.52 (5.00)	174	0.800 (2.625)	4598 (15086)
	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
	4.57 (15.00)	178	0.800 (2.625)	4495 (14747)
	6.10 (20.00)	NR	0.800 (2.625)	ERR*1
S41	0.08 (0.25)	186	0.800 (2.625)	4302 (14113)1
100 fra) fra 1 rea eus eus 200 200 200 200 200 10	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
***************************************	3.05 (10.00)	166	0.800 (2.625)	4820 (15813)
*Low Measuren	nent ¹ Sį	palled	² Edge Delaminati	ion ³ Cracked

Table A-2			
Pulse Velocity M	easurements fi	rom South	Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Time of Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S41	4.57 (15.00)	171	0.800 (2.625)	4679 (15351)
	6.10 (20.00)	183	0.800 (2.625)	4372 (14344)
S42	0.08 (0.25)	393	0.800 (2.625)	2036 (6679)*1
**********	1.52 (5.00)	165	0.800 (2.625)	4849 (15909)
	3.05 (10.00)	167	0.800 (2.625)	4791 (15719)
	4.57 (15.00)	171	0.800 (2.625)	4679 (15351)
	6.10 (20.00)	178	0.800 (2.625)	4495 (14747)
S43	0.08 (0.25)	186	0.800 (2.625)	4302 (14113)
********************	1.52 (5.00)	172	0.800 (2.625)	4652 (15262)
	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	6.10 (20.00)	177	0.800 (2.625)	4520 (14831)
S44	0.08 (0.25)	179	0.800 (2.625)	4470 (14665)
	1.52 (5.00)	177	0.800 (2.625)	4520 (14831)
***************************************	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
*******************************	4.57 (15.00)	178	0.800 (2.625)	4495 (14747)
	6.10 (20.00)	175	0.800 (2.625)	4572 (15000)
S45	0.08 (0.25)	177	0.800 (2.625)	4520 (14831)
	1.52 (5.00)	176	0.800 (2.625)	4546 (14915)
	3.05 (10.00)	173	0.800 (2.625)	4625 (15173)
	4.88 (16.00)	173	0.800 (2.625)	4625 (15173)
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	6.10 (20.00)	178	0.800 (2.625)	4495 (14747)
S46	0.08 (0.25)	187	0.800 (2.625)	4279 (14037)
	1.52 (5.00)	171	0.800 (2.625)	4679 (15351)
	3.05 (10.00)	171	0.800 (2.625)	4679 (15351)
*************************	4.57 (15.00)	175	0.800 (2.625)	4572 (15000)
***************************************	6.10 (20.00)	186	0.800 (2.625)	4302 (14113)
S47	0.08 (0.25)	179	0.800 (2.625)	4470 (14665)
	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
P++ + + + + + + + + + + + + + + + + + +	3.05 (10.00)	175	0.800 (2.625)	4572 (15000)
				tion ³ Cracked

Table A-2	
Pulse Velocity	Measurements from South Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S47	4.57 (15.00)	174	0.800 (2.625)	4598 (15086)
	5.79 (19.00)	177	0.800 (2.625)	4520 (14831)
S48	0.08 (0.25)	182	0.800 (2.625)	4396 (14423)
	1.52 (5.00)	175	0.800 (2.625)	4572 (15000)
	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
	4.57 (15.00)	179	0.800 (2.625)	4470 (14665)
	5.79 (19.00)	181	0.800 (2.625)	4420 (14503)
S49	0.08 (0,25)	spalled	0.800 (2.625)	ERR*
	1.52 (5.00)	167	0.800 (2.625)	4791 (15719)
	3.05 (10.00)	166	0.800 (2.625)	4820 (15813)
	4.57 (15.00)	172	0.800 (2.625)	4652 (15262)
	6.10 (20.00)	172	0.800 (2.625)	4652 (15262)
S50	0.08 (0.25)	176	0.800 (2.625)	4546 (14915)
	1.52 (5.00)	176	0.800 (2.625)	4546 (14915)
	3.05 (10.00)	174	0.800 (2.625)	4598 (15086)
	4.57 (15.00)	175	0.800 (2.625)	4572 (15000)
	6.10 (20.00)	177	0.800 (2.625)	4520 (14831)
S51	0.08 (0.25)	175	0.800 (2.625)	4572 (15000)
	1.52 (5.00)	172	0.800 (2.625)	4652 (15262)
	3.05 (10.00)	171	0.800 (2.625)	4679 (15351)
	4.57 (15.00)	177	0.800 (2.625)	4520 (14831)
	6.10 (20.00)	187	0.800 (2.625)	4279 (14037)
S52	0.08 (0.25)	spalled	0.800 (2.625)	ERR*
******************************	1.52 (5.00)	172	0.800 (2.625)	4652 (15262)
	3.05 (10.00)	178	0.800 (2.625)	4495 (14747)
	4.57 (15.00)	171	0.800 (2.625)	4679 (15351)
	6.10 (20.00)	390	0.800 (2.625)	2052 (6731)* ³
S53	0.08 (0.25)	357	0.800 (2.625)	2241 (7353)*3
	1.52 (5.00)	167	0.800 (2.625)	4791 (15719)
***************************************	3.05 (10.00)	168	0.800 (2.625)	4763 (15625)
Low Measure	ment lo	palled	² Edge Delaminat	tion ³ Crac

Table A-2
Pulse Velocity Measurements from South Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S53	4.57 (15.00)	172	0.800 (2.625)	4652 (15262)
	6.10 (20.00)	184	0.800 (2.625)	4348 (14266)
S54	0.08 (0.25)	170	0.800 (2.625)	4706 (15441)
	1.52 (5.00)	172	0.800 (2.625)	4652 (15262)
50000000000000000000000000000000000000	3.05 (10.00)	170	0.800 (2.625)	4706 (15441)
	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
	6.02 (19.75)	172	0.800 (2.625)	4652 (15262)
S 55	0.08 (0.25)	175	0.800 (2.625)	4572 (15000)
	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
	3.05 (10.00)	175	0.800 (2.625)	4572(15000)
	5.18 (17.00)	175	0.800 (2.625)	4572 (15000)
	6.10 (20.00)	181	0.800 (2.625)	4420 (14503)
S56	0.08 (0.25)	182	0.800 (2.625)	4396 (14423)
	1.52 (5.00)	174	0.800 (2.625)	4598 (15086)
	3.05 (10.00)	171	0.800 (2.625)	4679 (15351)
	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
	6.02 (19.75)	176	0.800 (2.625)	4546 (14915)
S57	0.08 (0.25)	177	0.800 (2.625)	4520 (14831)
	1.52 (5.00)	171	0.800 (2.625)	4679 (15351)
	3.05 (10.00)	170	0.800 (2.625)	4706 (15441)
	4.57 (15.00)	172	0.800 (2.625)	4652 (15262)
	6.02 (19.75)	204	0.800 (2.625)	3922 (12868)
S58	0.08 (0.25)	247	0.800 (2.625)	3239 (10628)*
	1.52 (5.00)	171	0.800 (2.625)	4679 (15351)
	3.05 (10.00)	171	0.800 (2.625)	4679 (15351)
	4.57 (15.00)	170	0.800 (2.625)	4706 (15441)
***************************************	6.02 (19.75)	182	0.800 (2.625)	4396 (14423)
S59	0.08 (0.25)	430	0.800 (2.625)	1861 (6105)*3
· 44 042 642 644 646 642 644 662 644 64	1.52 (5.00)	167	0.800 (2.625)	4791 (15719)
	3.05 (10.00)	170	0.800 (2.625)	4706 (15441)
*Low Measuren	nent ¹ S	bellec	² Edge Delamina	tion ³ Cracke

Table A-2
Pulse Velocity Measurements from South Seawall

	Location	Time of	·	
Monolith	Distance from West End of Monolith m (ft)	Arrival microseconds	Path Length m (ft)	Pulse Velocity m/s (ft/s)
S59	4.57 (15.00)	171	0.800 (2.625)	4679 (15351)
*********************	5.94 (19.50)	168	0.800 (2.625)	4763 (15625)
\$60	0.08 (0.25)	273	0.800 (2.625)	2931 (9615)*
	1.52 (5.00)	167	0.800 (2.625)	4791 (15719)
	3.05 (10.00)	167	0.800 (2.625)	4791 (15719)
	4.57 (15.00)	166	0.800 (2.625)	4820 (15813)
	6.02 (19.75)	173	0.800 (2.625)	4625 (15173)
S61	0.08 (0.25)	173	0.800 (2.625)	4625 (15173)
	1.52 (5.00)	170	0.800 (2.625)	4706 (15441)
	3.05 (10.00)	169	0.800 (2.625)	4734 (15533)
	4.57 (15.00)	167	0.800 (2.625)	4791 (15719)
	5.94 (19.50)	172	0.800 (2.625)	4652 (15262)
S62	0.08 (0.25)	179	0.800 (2.625)	4470 (14665)
	1.52 (5.00)	166	0.800 (2.625)	4820 (15813)
	3.05 (10.00)	168	0.800 (2.625)	4763 (15625)
	4.57 (15.00)	169	0.800 (2.625)	4734 (15533)
	5.94 (19.50)	176	0.800 (2.625)	4546 (14915)
S63	0.08 (0.25)	238	0.800 (2.625)	3362 (11029)*3
	1.52 (5.00)	169	0.800 (2.625)	4734 (15533)
	3.05 (10.00)	168	0.800 (2.625)	4763 (15625)
	4.57 (15.00)	168	0.800 (2.625)	4763 (15625)
	6.10 (20.00)	320	0.800 (2.625)	2500 (8203)* ³
S64	0.08 (0.25)	178	0.800 (2.625)	4495 (14747)
000 000 000 0000 000 000 000	1.52 (5.00)	170	0.800 (2.625)	4706 (15441)
	3.05 (10.00)	171	0.800 (2.625)	4679 (15351)
	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
	6.10 (20.00)	175	0.800 (2.625)	4572 (15000)
S65	0.08 (0.25)	178	0.800 (2.625)	4495 (14747)
***************************************	1.52 (5.00)	173	0.800 (2.625)	4625 (15173)
	3.05 (10.00)	171	0.800 (2.625)	4679 (15351)
*Low Measure	ment ¹ Si	palled	² Edge Delamina	tion ³ Cracl

Table A-2
Pulse Velocity Measurements from South Seawall

	Location	Time of		
Monolith	Distance from West End of Monolith M (ft)	Arrival microseconds	Path Length M (ft)	Pulse Velocity M/s (ft/s)
S65	4.88 (16.00)	180	0.800 (2.625)	4445 (14583)
	5.94 (19.50)	176	0.800 (2.625)	4546 (14915)
S66	0.08 (0.25)	177	0.800 (2.625)	4520 (14831)
	1.52 (5.00)	171	0.800 (2.625)	4679 (15351)
	3.05 (10.00)	175	0.800 (2.625)	4572 (15000)
	4.57 (15.00)	175	0.800 (2.625)	4572 (15000)
	6.02 (19.75)	180	0.800 (2.625)	4445 (14583)
S67	0.08 (0.25)	503	0.800 (2.625)	1591 (5219)* ¹
	1.52 (5.00)	169	0.800 (2.625)	4734 (15533)
PO 000 0000 DNG 000 000 000	3.05 (10.00)	170	0.800 (2.625)	4706 (15441)
*****************	4.57 (15.00)	170	0.800 (2.625)	4706 (15441)
	6.02 (19.75)	245	0.800 (2.625)	3266 (10714)*1
S68	0.08 (0.25)	172	0.800 (2.625)	4652 (15262)
	1.52 (5.00)	167	0.800 (2.625)	4791 (15719)
	3.05 (10.00)	168	0.800 (2.625)	4763 (15625)
	4.57 (15.00)	171	0.800 (2.625)	4679 (15351)
	6.02 (19.75)	171	0.800 (2.625)	4679 (15351)
S69	0.08 (0.25)	175	0.800 (2.625)	4572 (15000)
	1.52 (5.00)	167	0.800 (2.625)	4791 (15719)
	3.05 (10.00)	170	0.800 (2.625)	4706 (15441)
	4.57 (15.00)	169	0.800 (2.625)	4734 (15533)
	6.02 (19.75)	172	0.800 (2.625)	4652 (15262)
S70	0.08 (0.25)	175	0.800 (2.625)	4572 (15000)
	1.52 (5.00)	174	0.800 (2.625)	4598 (15086)
	3.05 (10.00)	177	0.800 (2.625)	4520 (14831)
	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
	6.10 (20.00)	178	0.800 (2.625)	4495 (14747)
S71	0.08 (0.25)	175	0.800 (2.625)	4572 (15000)
P0 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1.52 (5.00)	174	0.800 (2.625)	4598 (15086)
	3.05 (10.00)	177	0.800 (2.625)	4520 (14831)

Table A-2
Pulse Velocity Measurements from South Seawall

Loc	cation	Time of		
Monolith	Distance from West End of Monolith M (ft)	Arrival microseconds	Path Length M (ft)	Pulse Velocity M/s (ft/s)
S71	4.57 (15.00)	173	0.800 (2.625)	4625 (15173)
***************************************	6.10 (20.00)	178	0.800 (2.625)	4495 (14747)
S72	0.08 (0.25)	spalled	0.800 (2.625)	ERR*
)	1.52 (5.00)	174	0.800 (2.625)	4598 (15086)
7.000 230 240 200 4 200 200 200 200 200 200 200 200 200 20	3.05 (10.00)	176	0.800 (2.625)	4546 (14915)
••••••••••••••••••••••••••••••••••••••	4.57 (15.00)	170	0.800 (2.625)	4706 (15441)
***************************************	6.10 (20.00)	spalled	0.800 (2.625)	ERR*
573	0.08 (0.25)	176	0.800 (2.625)	4546 (14915)
000 000 000 000 000 000 000 000 000 00	0.91 (3.00)	168	0.800 (2.625)	4763 (15625)
***************************************	1.83 (6.00)	170	0.800 (2.625)	4706 (15441)
*******************************	2.13 (7.00)	131	0.800 (2.040)	4750 (15585)
· · · · · · · · · · · · · · · · · · ·	3.35 (11.00)	137	0.800 (2.040)	4542 (14903)
9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	4.88 (16.00)	135	0.800 (2.040)	4610 (15124)
************************	6.40 (21.00)	133	0.800 (2.040)	4679 (15351)
*Low Measureme	nt ¹Si	palled	² Edge Delamination	³ Cracke

Appendix B Petrographic Examination

Corps of Engineers, USAE Waterways Experiment Station	Concrete Report	Structures Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180
Project: Perry's Victory Monument, Seawall		Date: August 2, 1995

Samples

I. Twenty seven, 102-mm (4-in.) diameter cores taken from top of seawalls were received for examination and testing to determine the cause of cracking in the concrete. The cores were assigned CTD serial numbers as described in Table B-1. These serial numbers will be used to describe the samples examined and tested.

Table B-1 Core Samples			
CTD Sample No.	Field Id.	CTD Sample No.	Field Id.
950372	S7	950386	S68
950373	S8	950387	S72
950374	S16	950388	N10
950375	S16/17	950389	N11
950376	S17	950390	N21
950377	S17B	950391	N22
950378	S27	950392	N30
950379	S20	950393	N38
950380	S37	950394	N45
950381	S49	950395	N56
950382	S52A	950396	N57
950383	S52B	950397	N34, old seawall
950384	S60A	950398	N40, old seawall
950385	S60B		

Procedure

- II. A log was made of each core describing the general composition and condition of the concrete. Generally intact pieces of core having a length to diameter ratio of 2:1 were designated for compressive-strength test specimens. They were indicated on the core logs as C/S. Selected samples were examined in more detail using guidance from "Standard Practice for Petrographic Examination of Hardened Concrete," CRD-C 57 (ASTM C 856).
- III. Slabs cut from cores were prepared according to "Standard Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete," CRD-C 42 (ASTM C 457) and tested to determine the air-void parameters of the concrete.
- IV. Specific gravities and absorption values were determined for selected individual aggregate particles removed from cores. Determinations were made according to "Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate," CRD-C 107 (ASTM C 127).

Results

- V. The cores consisted of concrete from the north, south, and old seawalls (logs of core are presented in Figures B-1 through B-27). Concrete from both north and south seawalls were similar in composition. Both consisted of air-entrained concrete, made using crushed and natural limestone coarse aggregates, and natural limestone fine aggregate. All showed no segregation and generally good consolidation. The individual descriptions are shown in the logs. Many of the cores contained open fractures running along the length of the core as well as normal to its length. In some cores the fractures were random, diagonal and in some, the cores had separated into rubble during the coring operation (Figures B-28 through B-31).
- VI. Many of the fractures were parallel to subparallel cracks. Some tended to be subparallel to the surface of the structure. Examination of photographs show the cracks and fractures are at edges, corners, and near exposed surfaces. Some of the cores show incipient fractures with only a slight indication of crack propagation while other were open and others consisted of multiple cracks causing the concrete to be rubble.
- VII. Some of the deterioration in the form of cracking went to full depth of the core having 0.46 m (1.5 ft) depths. More commonly the depth of deterioration was limited to about 0.15 m (0.5 ft).
- VIII. The old seawall concrete (950397 and 950398) contained a natural siliceous coarse aggregate and a natural siliceous fine aggregate. It contained

some entrained air voids. Examination of aggregate particles indicated some to be low refractive index chert.

- IX. Reaction rims were observed in coarse aggregate of the concrete from the north and south seawalls. When acid was used to etch the particles, some showed negative rimming in which the rims more easily dissolved but most rims showed no relief when etched.
- X. White reaction products were common in cracks. Some of the reaction completely filled air voids. Reaction product filling voids was identified as ettringite. Alkali-silica reaction (ASR) gel was present in limited amounts in some cracks. ASR gel was abundant in the concrete from the old seawall in which the fractured surfaces were coated with material.
- XI. Coarse aggregate particles were mostly dolomitic limestone with some containing trace amounts of clay and some quartz (X-ray diffraction patterns are shown in Figures B-32 through B-44). Some contained only dolomite as a mineral constituent.
- XII. Reinforcing steel for the most part was free of corrosion products. Only slight corrosion was observed on the steel in the cores.
- XIII. The concrete contained some entrained air in both the old and recent concrete (Table B-2). It however shows a wide range of total air ranging from a high of near six percent to a low of near one percent. Spacing factors show a range of 0.780 to 0.213 mm (0.0307 to 0.0084 in.). Sample 950375A and 950375B were from a core drilled through a joint representing concrete from monoliths S16 and S17 of the south seawall. Adjacent monolith in this case showed spacing factors to be significantly different.

Table B-2 **Characteristics of Concrete Parameters** Sample 950375A 950375B 950385 950398 950395 950396 (S17)(S16) (S60B) (N40, (N56)(N57)Old Seawall) Coarse 45.6 26.3 41.0 36.7 32.3 38.6 Aggregate, % Fine 25.3 31.2 27.8 34.2 31.3 25.6 Aggregate, % Paste, % 29.1 23.4 40.7 28.1 28.0 30.3 2.7 Entrained 3.4 0.5 1.4 0.5 2.4 Voids, % 2.3 4.3 Entrapped 1.3 1.7 0.6 3.4 Voids, % Total Air, 5.7 1.1 6.1 6.7 1.8 3.1 % 0.213 0.789 0.470 0.282 0.236 0.335 Spacing Factor, mm (0.0084)(0.0307)(0.0185)(0.0111)(0.0093)(0.0132)(in.)

XIV. Specific gravities for the coarse aggregate ranged from a low of 2.16 to a high of 2.89 (Table B-3). Absorption correlated with specific gravity in that particles with low specific gravities also indicated high absorption. Absorption ranged from less than 1 percent to more than 11 percent. Bulk specific gravities for the particles as well as absorptions are presented below:

		ggregate
Sample Id.	Bulk Specific Gravity	Absorption, %
Α	2.36	4.82
В	2.42	4.43
С	2.16	11.29
Α	2.39	5.08
Α	2.12	6.98
В	2.63	1.85
С	2.57	1.74
D	2.89	0.52
Е	2.53	3.36
Α	2.55	0.65
В	2.26	1.46
C*	2.60	1.44
Α	2.34	5.94
В	2.20	9.09
AVERAGE	2.45	4.45

Conclusion and Discussions

XV. Concrete deterioration is most likely related to lack of resistance to freezing and thawing while critically saturated. Entrained air should provide a spacing factor of 0.203 mm (0.008 in.) or less to provide adequate protection from stresses associated with freezing and thawing of critically saturated concrete. Examination of concrete in adjacent monoliths show that one may be protected while the other may be susceptible to freezing and thawing deterioration.

XVI. Aggregate particles with low specific gravities and high absorption usually are not resistant to freezing and thawing. In many places specific gravities of less than

2.40 are indications of potential problem aggregates. Some of the aggregates had high absorption and could be traced to some durability problems as popouts were observed on concrete surfaces. Problems associated with nondurable aggregate in this case would be associated with edges and corners where the concrete has the highest potential for saturation.

XVII. The dolomitic limestone shows some reaction rims around aggregate particles indicating some alkali-carbonate rock reaction. This reaction does not appear to be a problem as there was no evidence joint closure in the structure or possible displacement.

XVIII. Some alkali-silica reaction was observed in some near surface cracks. The gel in the recent concrete was limited to partially coating some fractures and appears to be very limited in extent. Alkali-silica reaction was much more extensive in one core representing the concrete from old seawall and was not evident in the core that was intact. The concrete was rubble where ASR was observed in the old concrete. ASR may be a major deteriorating cause in the old concrete.

XIX. Corrosion of steel was minor and does not appear to be sufficient in the limited samples taken to be a cause of concrete cracking. As the structure ages and the concrete along open cracks and adjacent to the steel carbonates thus reducing the pH in the concrete around the steel and the open channel allows water and air penetration, corrosion of steel could become a problem causing spalling and staining of the concrete.

DRILL	ING LOC	;	DIVISION	NAD	INSTALLATI	ON	•		SHEET 1	7
1. PROJECT			1 - 774		10. SIZE				OF 1 SHEETS	┨
2. LOCATION	(Coardina	erry	's Vict	ory	11. DATUM	FOR ELEV	ATION SHO	OWN (TBM OR MS	SL)	7
			,		12. MANU!	ACTURER'S	DESIGNAT	ION OF DRILL		1
3. DRILLING	AGENCY				13. TOTAL	NO OF O	VFR-	DISTURBED	UNDISTURBED	4
4. HOLE NO.		n on dr	awing title	N34		N SAMPLES			CHEISTONSES	-
and file n					14. TOTAL	NUMBER C	ORE BOXE	s		┥
6 0105071011	05 11015				15. ELEVAT	ION GROUI				
6. DIRECTION VERTICAL			o	DEG. FROM VERT	16. DATE	HOLE	STAR	TED	5-24-95]
7. THICKNESS					17. ELEVAT					7
8. DEPTH DR					19. SIGNAT			BORING		-
9. TOTAL DEP	TH OF HO	re 0	-	•		,	,	,		
ELEVATION	DEPTH	LEGEND		(Description)	S	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tim	REMARKS e, water loss, depth of , etc. if significant)]
0	0.0						N34	www.community	, etc. it significant)	+
]		Rubbl		10.5					
			Locat	ed at joint 34 cated Surface	/35					
				eous FA natura	1					
				acture particl						
			CID #	950397						
	_									
										_
	\vdash		Petro	graphy - Chert						_
	\vdash		Some	rse aggregate entrained air	voide			,		\vdash
	⊢			filled with A						\vdash
ì			gel	and ettringit	е					-
										\vdash
										\vdash
										\vdash
										\vdash
			ļ							
}										_
										<u></u>
. [\dashv									L
	\dashv									-
	4									\vdash
	-									-
										-
	\dashv									-
	7									-
									•	\vdash
	. 7									-
	\neg									-
										\vdash

Figure B-10. Log for North seawall core N34 (Old Seawall)

DDULL	NO LOC	1	IVISION		INSTALLATIO	ON			SHEET 1	
	NG LOG			NAD	10 6775	ND TYPE 2	E DIT 4		OF 1 SHEET	S
1. PROJECT	Pe	errv	's Vict	ory	10. SIZE A	FOR ELEV	ATION SHO	NYN (TBM OR M	SL)	\dashv
2. LOCATION	(Coordinat	es or S	itation)		<u> </u>					
3. DRILLING A	GENCY			 	12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL		1
3. DRILLING F	GENCI				13. TOTAL	NO. OF OV	ÆR-	DISTURBED	UNDISTURBED	_
4. HOLE NO.		on dr	awing title	N57	BURDEI	N SAMPLES	TAKEN			ŀ
and file n				1107	14. TOTAL	NUMBER C	ORE BOXE	S		┥
J. NAME OF	MILLER				15. ELEVAT					7
6. DIRECTION					16. DATE	101 F	STAR	TED	COMPLETED	
VERTICAL		TNED (<u> </u>	DEG. FROM VERT			5 11015		5-24-95	_
7. THICKNESS					17. ELEVAT			R BORING	<u> </u>	
8. DEPTH DRI					19. SIGNAT					_
9. TOTAL DEP	TH OF HO	E 1.4								_
ELEVATION	DEPTH	LEGEND		CLASSIFICATION OF MATERIAL	LS	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tim	REMARKS ne. water loss, depth o	r
		A :- T	,	(Description)		ERY		weatherin	ne, water loss, depth og, etc. if significant)	
0	0.00	6 2 6	Finis	shed top surfac	e		N57			L
	_									
]	_	O SE	2							
	→		4							_
			9							
	_	98°0								\vdash
		2000	8							L
	:	29 B	9.							_
	_	86 B	8							L
		800								L
	-	2 A								L
	_		3			İ				\vdash
	, and	8.50	3							\perp
-1.4	1.40		EOB 1	L.4-ft						_
			Locat	ed at joint 57	7/58]		\vdash
			1 1/2	2-in max size	,,50	1				\vdash
	-		nat	cural/ crushed	Ls CA	1				\vdash
	-			cal Ls FA						-
				rous entrapped entrained	air					
	-			egregation						\vdash
	-									\vdash
	-		CTD :	\$ 950396						-
	-									\vdash
										\vdash
										\vdash
1	⊢									-
1	-									-
	-							-		\vdash
										-
	-									-
	-									-
	-									\vdash
	-		1							-
	-									-

Figure B-9. Log for north seawall core N57

DRILL	ING LOG	DIVISION	NAD	INSTALLATI	ÓN				1
1. PROJECT	Dorr	ula Viet		10. SIZE A	ND TYPE	OF BIT 4.	-in	OF 1	SHEETS
2. LOCATION	(Coordinates o	y's Vict r Station)	LOLY	11. DATUM	FOR ELEV	ATION SH	OWN (TBM OR MS	SL)	
				12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL		
3. DRILLING	AGENCT			13. TOTAL	NO. OF O	VER-	DISTURBED	UNDISTURE	BED.
4. HOLE NO.	(As shown on	drawing title	N56	•	N SAMPLES				
5. NAME OF				14. TOTAL	NUMBER C	ORE BOXE	S		
6. DIRECTION	OF HOLF			15. ELEVAT	ION GROUI	ND WATER	TEO	L COLUBI STEE	
VERTICAL			DEG. FROM VERT	16. DATE	HOLE	SIAI	(IED	COMPLETED 5-24	-95
7. THICKNESS	S OF OVERBURD	EN		17. ELEVAT				·	
	ILLED INTO ROC			18. TOTAL 19. SIGNAT			R BORING		
9. TOTAL DES	PTH OF HOLE 1		NACCIFICATION OF AUTONO	<u></u>					
ELEVATION	DEPTH LEGE		CLASSIFICATION OF MATERIAL (Description)	.S	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling time	REMARKS e, water loss, j, etc. if signii	depth of ficant)
-1.4	1.40	Petro Open Incir of C/S C/S EOB 1 Locat 1 1/2 nat Natur Numer Air e	crack to 2-in pient crack len core 4-ft new ed at joint 56 cural/ crushed cal Ls FA cous entrapped entrained egregation 1950395	depth gth /57 Ls CA	LRI	N56	weathering	, etc. if signii	[icant)

Figure B-8. Log for north seawall core N56

DD:***	NO LOG	DIV	/ISION		INSTALLATIO	N			SHEET 1	٦
	NG LOG			NAD	10 6177	ID TURE O	C OF 4	i n	OF 1 SHEETS	4
1. PROJECT	Pe	rry'	s Vict	ory	10. SIZE A			111 IWN (TBM OR MS	SL)	1
2. LOCATION	(Coordinate:	s or Sto	tion)		12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL		\dashv
3. DRILLING A	AGENCY			<u>, , , , , , , , , , , , , , , , , , , </u>	1			DISTURDED	LINDIGTURGES	4
4. HOLE NO.		on drav	ring title	N45	13. TOTAL BURDEI	NO. OF OV		DISTURBED	UNDISTURBED	
and flie n					14. TOTAL	NUMBER C	ORE BOXES	3		1
					15. ELEVAT	ION GROUN		vers.	1.00//015555	\Box
6. DIRECTION VERTICAL		NED []		DEG. FROM VERT	16. DATE I		STAR	TED	5-24-95	1
7. THICKNESS	OF OVERBU	JRDEN			17. ELEVAT			DAD!!!		7
8. DEPTH DRI	LLED INTO F	ROCK			18. TOTAL 19. SIGNAT			BORING		\dashv
9. TOTAL DEP	TH OF HOLE	1.3			•	OI III				
ELEVATION	DEPTH L	EGEND	C	CLASSIFICATION OF MATERIAL (Description)	rz	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tim	REMARKS ne, water loss, depth of g, etc. if significant)	1
0	0.00 8			shed top surfac	ce		N45			Ţ
	2	Dai		ace crack						
		088	No re	eal vertical						L
	-0	2000	EACE!	s - 4 44						
	P 54	, ac. 6								-
	-[80								ŀ
	- g	2								-
	- 6	G088	C/S							ŀ
		O 0								1
		038								ŀ
	- 0	000								H
		8008								ŀ
-1.3	1.30	0	EOB 1	L.3-ft new						ŀ
										ŀ
,			Locat	ed at joint 44	4/45					ı
				2-in max. size cural/ crushed						
			Natur	ral Ls FA						
			Some	entrapped void	ds					
				entrained						
		İ	140 S6	egregation						
		1	CTD #	\$950394	-					-
										-
	-]				-
									,	ŀ
	-									-
] -							1		-
] -									ŀ
	-									ŀ
	-									-
	-									ŀ
	-									-
	-						İ			
										ŀ
										ŀ

Figure B-7. Log for north seawall core N45

DRILL	ING LOG	DIVISION	NAD	INSTALLAT	ON				SHE	т 1		٦
1. PROJECT				10. SIZE	ND TYPE	OF BIT	4-	in	OF	1	SHEETS	-
0 100171011	Perry (Coordinates or	y's Vict	ory	11. DATUM	FOR ELE	VATION	SHO	OWN (TBM OR MS	SL)			1
2. LUCATION	(Coordinates or	Station)		12. MANU	ACTURER'S	S DESIG	GNAT	ION OF DRILL				4
3. DRILLING	AGENCY											
4. HOLE NO.	(As shown on	drawing title	1100	13. TOTAL BURDE	NO. OF O			DISTURBED	UND	STURB	ED	
and file i	number)		N38					<u> </u>				_
5. NAME OF	DRILLER .			14. TOTAL 15. ELEVA				S				4
6. DIRECTION			·				STAR	TED	COMPLET	TED		┨
VERTICAL			DEG. FROM VERT	16. DATE					5	-24-	95	
	S OF OVERBURDE			17. ELEVA				BORING				7
	PTH OF HOLE O			19. SIGNA				DORMO				┨
9. TOTAL DE	I I		CLASSIFICATION OF MATERIAL			Taran						_
ELEVATION	DEPTH LEGEN		(Description)		% CORE RECOV- ERY	BOX SAMI NO	OR PLE).	(Drilling time	REMARKS e, water , etc. if		iepth of icant)	
0	0.0_	Finis	shed top surfac	e		N3	8					
	-0.0											
	-000	id o										
ļ	-5000	0			:							
		<u> </u>										-
-0.6	0.60	EOB ().6-ft									\vdash
		100	20									\vdash
		Locat	ed at joint 37	/38								\vdash
		Incip	ient cracks le core through C	ngth 'a								
			e-in max. size	ar.								\vdash
			ural/ crushed	Ls CA								
	-		cal Ls FA Cous entrapped	voide		1						
	-	Some	entrained void	.s								_
		No se	gregation									-
		CTTD	950393									\vdash
		0.12 "	330333									\vdash
						ĺ	ĺ					上
												上
	\dashv											
												L
	-											F
												-
	_	į.					ł					\vdash
												\vdash
												卜
												一
	_											
	-											L
	\dashv				İ		İ					F
												-
		<u></u>										H

Figure B-6. Log for north seawall core N38

DRILLI	NG LOC	;]	DIVISION	NAD	INSTALLATIO	Ж				SHEET 1 OF 1 SHEETS	7
1. PROJECT		1	's Vict		10. SIZE A	ND TYPE O	F BIT 4	-in HOWN (TBM OR	MSL)	Of I STEETS	7
2. LOCATION	(Coordina	tes or	Station)		12. MANUF	ACTURER'S	DESIGNA	ATION OF DRILL			-
3. DRILLING A	GENCY										_
4. HOLE NO.		n on d	rawing title	N30	13. TOTAL BURDEN	NO. OF OV		DISTURBED	'	UNDISTURBED	
and file n				L	14. TOTAL	NUMBER C	ORE BOX	ŒS			1
					15. ELEVAT	ION GROUN					7
6. DIRECTION VERTICAL			o	DEG. FROM VERT	16. DATE I	IOLE	ST	ARTED	CO	5-24-95	
7. THICKNESS	OF OVER	BURDE	4		17. ELEVAT						7
8. DEPTH DRI	LLED INTO	ROCK			18. TOTAL 19. SIGNAT						4
9. TOTAL DEP	TH OF HO	LE 1.	3 feet		13. SIGNAL	OKE OF IR	SI LOIO	•			-
ELEVATION	DEPTH	LEGEN		CLASSIFICATION OF MATERIAL (Description)	s	% CORE RECOV- ERY	BOX O SAMPLI NO.			MARKS rater loss, depth of c. if significant)	
	0 0	1466	Pini			6101	-		ring, et	c. if significant)	+-
0	0.0_	30	rinis	shed top surfac	,e		N30				
	_	000	C/S								\vdash
	-		ğ					1			-
	_	0.00	j				1				\vdash
		90	8								\vdash
	_	್ಯಾಂ	ğ								\vdash
	_	90%	\$								-
	_	See S	Petro	ography							\vdash
	_	000	8	- J <u>F</u> 2							\vdash
			3								
	_	8									L
		>646°	\$			ļ					L
		800	13								-
-1.3	1.30		EOB :	1.3-ft new			ļ				\vdash
				ted at joint 29	9/30						
	_			2-in max. size							\vdash
İ	_			tural/ crushed ral Ls FA	Ls CA						
	_	1		entrapped void	is.						\vdash
		1	Air	entrained							
		1		egregation		[
ĺ	_			U0E0366							_
	_	1	CTD	#950392					*		
	_					1					
	-										_
	-	1	Petro	ography - Acid							
	-	1		ched shows no	relief		1				\vdash
1	-	1	in	reaction rims							\vdash
	-	1									-
	_	<u> </u>									
]									
	1 ~]									Г
	-	1									
1	-	1									
	_	1					1				
		1									
		1				<u> </u>					

Figure B-5. Log for north seawall core N30

DRILL	ING LOG	DIVISION	NAD	INSTALLAT	ON	 ·		SHEET 1	
1. PROJECT				10. SIZE	NO TYPE	OF BIT 4	-in	OF 1	SHEETS
		y's Vict	cory	11. DATUM	FOR ELEV	ATION SI	IOWN (TBM OR M	SL)	
2. LOCATION	(Coordinates o	Station)		12 MANUE	ACTUBERS	DESIGNA	TION OF DRILL		
3. DRILLING	AGENCY				ACTORER 3	DESIGNA	TION OF BRILL		
4 1101 5 110	/4t	d1 A141 -		13. TOTAL			DISTURBED	UNDISTURBE	D
and file	(As shown on number)	arawing title	N22	BURDE	N SAMPLES	TAKEN		İ	
5. NAME OF	DRILLER		· · · · · · · · · · · · · · · · · · ·	14. TOTAL	NUMBER C	ORE BOX	ES		
6. DIRECTION	OF HOLE			15. ELEVAT	ION GROU				
VERTICAL			DEG. FROM VERT	16. DATE	HOLE	214	RTED	COMPLETED 5-24-9	0.5
7. THICKNESS	S OF OVERBURDS	N.		17. ELEVAT	ION TOP C	F HOLE		3-24-	95
8. DEPTH DR	ILLED INTO ROCE	<		18. TOTAL					
9. TOTAL DE	PTH OF HOLE 1	.4 feet		19. SIGNAT	URE OF IN	ISPECTOR			
			CLASSIFICATION OF MATERIAL	s	% CORE	BOX OR		REMARKS	
ELEVATION	DEPTH LEGER		(Description)		% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tim weathering	e, water loss, de , etc. if signific	epth of cant)
0	0.0	Finis	shed top surfac	е		N22			
	_0	70 2 pie	ces 3/4-in rei cing steel	n-					
	- 5	Poor	consolidation						
		arc	ound steel						
İ	_200		corrosing of	upper			ļ		
!	- 200	d bar					i		
	- 69								_
	- 300	29							
	7000	Ď							-
	8.00	8							-
	- 35 50								-
-1.4	1.40	EOB 1	.4-ft new						F
		Locat	ed at ladder r	ecess					
	-	1 1/2	-in max size						-
			ural/ crushed : al Ls FA	Ls CA	1				\vdash
			ntrained						
		Numer	ous entrapped	air					
		No se	gregation						<u> </u>
		verti	cal and horizonipient cracks	ntal					
		Crack	s go through C	A.					
		React	ion rim around						
	4	som	e CA						
	4	CTD #	950391	ļ					
	\dashv	"			1				
	4								
	_				l				
İ					ĺ				
	-								L
	4								<u> </u>
	\dashv				.				-
}	\dashv								
									-

Figure B-4. Log for north seawall core N22

DRILL	ING LO	G-	DIVISION	NAD	INSTALLAT	ON			*****	SH	EET 1		SHEETS	ָ
1. PROJECT	, p	err	's Vict	orv	10. SIZE	ND TYPE (OF B	IT 4 -	in OWN (TBM OR MS				311,21,1	Ϊ
2. LOCATION	(Coording	ites or	Station)											╝
3. DRILLING	AGENCY				12. MANUI	FACTURER'S	DES	SIGNAT	ION OF DRILL					
						NO. OF O			DISTURBED	UI	NDISTU	RBED		┨
4. HOLE NO.		n on d	irawing title	N21	BURDE	N SAMPLES	TAP	KEN						
5. NAME OF	DRILLER					NUMBER C			S					
6. DIRECTION	OF HOLE				15. ELEVA		ND W	STAR	TED	COMP	ETED			-
VERTICAL	□ INC	CLINED	o	DEG. FROM VERT	16. DATE	HOLE			<u> </u>		5-24	4 - 9	5	
7. THICKNESS						CORE REC			PODINC .					_
8. DEPTH DRI						TURE OF IN			BORING					\dashv
9. TOTAL DEP	TH OF HO	DLE 1.		CLASSIFICATION OF MATERIA	416	Γ								_
ELEVATION	DEPTH	LEGEN		(Description)	ALS	% CORE RECOV- ERY	SA.	X OR MPLE NO.	(Drilling tim	REMAR e, wate . etc. i		i, de	pth o	r
0	0.0_	898	Finis	shed top surfa	се		N	21		,, , , , , , , , , , , , , , , , , , , ,			/	
	_	3000°	Fract	ure to 1-in d	enth									
	_	85.8		die co 1-in d	epcn									L
	_	8.0	8											\vdash
		0 8	C/S											-
	_	g Dig	3											-
Λ		88	2											-
		82	9											
		86	<u> </u>			}								
U	_		c/s											L
		S 8	0 0/3											\vdash
,	-	ૢૢૢ૽૾ૡ												-
Λ		og S	2	•										-
V		0 0	₹ ₹											-
-1.65	1.65	ν° Ά		.65-ft new		1								
	_													\perp
	-		Locat	ed near mid-le monolith	ength									-
				!-in max. size										
			nat	ural/ crushed										\vdash
				cal Ls FA cous entrapped	voids									
	_		Air e	entrained	VOLUB									
			No se	gregation										L
			CTD #	950390										\vdash
	-													-
														\vdash
	_				•									\vdash
														L-
	_													\vdash

Figure B-3. Log for north seawall core N21

	·									
DRILL	ING LOG	DIVISION	NAD	INSTALLAT	ION			SHEET	_	\Box
1. PROJECT				10. SIZE	AND TYPE	OF BIT 4	-in	OF	1 SHEET:	5
2 LOCATION	Perry (Coordinates or	y's Vict	cory	11. DATU	FOR ELE	VATION SI	OWN (TBM OR M	SL)		┨.
Z. LOCATION	(Coordingles of	Jidnoil)		12. MANU	FACTURER'S	S DESIGNA	TION OF DRILL			-
3. DRILLING	AGENCY						DINEL			
A HOLE NO	(As shown on e	Irawina tille			NO. OF O		DISTURBED	UNDIS	TURBED	7
'and file i	number)	y ine	N11	DONDE	JANIFUL	IANEN				ĺ
5. NAME OF	DRILLER				NUMBER (
6. DIRECTION	OF HOLE			15. ELEVA	TION GROU		RTED	COMPLETE	0	\exists
VERTICAL	□ INCLINED	D	DEG. FROM VERT	16. DATE	HOLE	317	,		24-95	
7. THICKNES	S OF OVERBURDE	N			TION TOP			1 3	21)	\dashv
8. DEPTH DR	ILLED INTO ROCK				CORE REC					
9. TOTAL DE	PTH OF HOLE 1	2 feet		19. SIGNA	TURE OF H	NSPECTOR				
ELEVATION	DEPTH LEGEN		CLASSIFICATION OF MATERIAL	S	% CORE	BOX OF	:	REMARKS		-
ELEVATION	DEPTH LEGEN		(Description)		% CORE RECOV- ERY	SAMPLE NO.	(Drilling tim	ne, water lo	ss, depth of	ε
0	0.0	Finis	shed top surfac	e		N11		g, dec, it as	gmilicant)	+
] 0,003	White	exudation in			51				\vdash
		sur	face cracks							-
	Б	Incir	ient fracture							\vdash
		to	1.5-in							
	- 20	ä			1					
	_ 90	Canal	at .20-ft is	-2.5						
	_ 300	e Clack	at .20-1t 1s	ora						
		Ŏ								
]					
		g C/S				-				L
-1.2	1 2 8, 09	TOD 1	2 64		Į.					L
-1.2	1.2_	FOR 1	2-ft new		ļ					<u> </u>
	_	Locat	ed at joint 11	/12	1	ŀ				\perp
		1 1/2	-in max. size							\vdash
	7		ural/ crushed	Ls CA			İ			\vdash
			al Ls FA entrapped air							\vdash
			ntrained air							\vdash
										\vdash
		CTD. #	950389							
İ					,					\vdash
		Petro	graphy - Exuda	tion						<u></u>
1		mat	erial is ASR							
	\dashv									
	_									
	4									
	\dashv									
	_									
	-									L
İ	4									L
ļ	\dashv			i						
İ	4				j					L
										_
										F
							i .			

Figure B-2. Log for north seawall core N11

DRILLI	NG LO	G	DIVISION	NAD	INSTALLATI	DN			SHEET	_ `	SHEETS	7
1. PROJECT	D	errv	's Vict	orv	10. SIZE A	ND TYPE (OF BIT 4 -	in OWN (TBM OR MS		_]
2. LOCATION	(Coording	ites or	Station)	.ory	III. DAIOM	FOR ELEV	ATION SHO	WN (IBM OR MS	L)	•		
3. DRILLING A	CENCY				12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL				7
3. DKILLING I	NOENCI				13. TOTAL	NO. OF O	VER-	DISTURBED	UNDIST	URBED		┨
4. HOLE NO.		n on di	rawing title	N10	BURDE	N SAMPLES	TAKEN					
5. NAME OF				L	14. TOTAL	NUMBER C	ORE BOXE	S				┨
					15. ELEVAT	ION GROUP						1
6. DIRECTION VERTICAL			o	DEG. FROM VERT	16. DATE	HOLE	STAR	TED	COMPLETED 5 ~ 2	24-9	5	7
7. THICKNESS	OF OVER	BURDEN			17. ELEVAI							
8. DEPTH DRI	LLED INTO	ROCK			18. TOTAL 19. SIGNAT			BORING				_
9. TOTAL DEP	TH OF H	DE 0	feet		19. SIGNAL	UKE OF IN	ISPECTOR					
ELEVATION	DEPTH	LEGENE		CLASSIFICATION OF MATERIAL	S	% CORE RECOV-	BOX OR		REMARKS			1
ELEVATION	DEPIN	LEGENI	<u></u>	(Description)		ERY	BOX OR SAMPLE NO.	(Drilling time weathering	, water lo , etc. if si	ss, de gnific:	pth of ant)	
0	0.0_		Rubbl				N10					
	_		Locat	ed at joint 9/	10							
	_		Grave	Disintergrati el size pieces	.on							
	_		024.0	- Dibo picoco								
			CTD #	950388								
	_											L
:	_						ĺ					L
	_											\vdash
	_											-
	_											\vdash
	_											\vdash
	_											\vdash
	_											\vdash
												-
												上
												F
	_						ļ					
							ļ					\vdash
	_											
												L
	-											L
					:							L
												_
	-											\vdash
	_	•						-				⊢
												\vdash
												\vdash
												\vdash
												
												
	_											十
ŀ												
											٠	

Figure B-1. Log for north seawall core N10

		DIVISION	N .			INSTALLATI	ΛN.						_
DRILL	ING LOG		N.	AD.		HOINLEAN	ON				SHEET	1 1 SHEETS	.
1. PROJECT						10. SIZE A	ND TYPE	OF BIT	٦4-	in		T 311EE13	Ή
2 LOCATION	(Coordinates		ictory			11. DATUM	FOR ELE	VATION	SH	OWN (TBM OR MS	L)		┑
2. LUCATION	(Coordinates	er sicilon)				12 MANUE	ACTUBED	DEE!	CNAT	ION OF DRILL			_
3. DRILLING	AGENCY					121	ACTOREK .	3 DESI	UHAI	ION OF DRILL			-
						13. TOTAL				DISTURBED	UNDIST	URBED	┨
4. HOLE NO.	(As shown o	on drawing (fifie	N40		BURDE	N SAMPLE	S TAK	EN	İ			ı
5. NAME OF						14. TOTAL	NUMBER	CORE I	BOXE	S			\dashv
						15. ELEVAT							┨
6. DIRECTION						16. DATE	HOLE		STAR	TED	COMPLETED)	\dashv
VERTICAL				DEG. FROM VER	PT .						5-2	24-95	1
7. THICKNESS						17. ELEVAT							コ
8. DEPTH DR						18. TOTAL 19. SIGNAT				BORING			_
9. TOTAL DEF	PTH OF HOLE	0.35 f	eet			is. Sidiki	OKE OF A	431 EC	IOK				
EL CATION	25221		CLASSIFI	CATION OF MAT	TERIALS	3	% CORE RECOV~	вох	OR		REMARKS		┥
ELEVATION	DEPTH LE	GEND		(Description)			RECOV~ ERY	SAM	PLE 0.	(Drilling time weathering,	, water los	s, depth of	,
0	0 %	Son Er	oded Su	rface		***		N4		weathering,	etc. II si	(nificant)	+-
				FA sta	ndir	na in		144	EU				\vdash
	-,9	000	relief,	some s	cali	ing							\vdash
	- 6	19°00				3							\vdash
-0.35	0.35	EO	B 0.35-	ft									
	-												
	_	Lo	cated a	t joint	40/	/41							L
				size s	ilic	ceous		1					
	-		natural liceous										Г
				olidati	On								
			segreg		OII								
	_		33	,									
		CI	D #9503	98									
		ĺ											F
													\vdash
													\vdash
													\vdash
									- 1				\vdash
	7												\vdash
	٦												\vdash
	7												\vdash
													-
	7			•									\vdash
	\dashv												-
	\dashv												-
	\dashv												L
						İ							_
	\dashv												L
]	\dashv	ĺ											L
ĺ	4												
	4	ĺ				ŀ							Γ
													Г
ĺ	_												
I													
							ĺ						H
													<u> </u>
													-
i													-
													\vdash

Figure B-11. Log for north seawall core N40 (Old Seawall)

DRILL	ING LOG	DIVISION	NAD	INSTALLATI	ON			SHEET 1	1
1. PROJECT		-		10. SIZE	ND TYPE	DF BIT 4 "		10r T	SHEETS
0.100:5:5:		's Vict	tory				OWN (TBM OR MS	SL)	
2. LOCATION	(Coordinates or	ztation)		12. MANUE	ACTUBERS	DESIGNAT	ION OF DRILL	······································	
3. DRILLING	AGENCY			12. MARUI	ACIURER'S	DESIGNAL	ION OF DRILL		
4 11015 110	76 3		,	13. TOTAL			DISTURBED	UNDISTURB	ED
and file n	(As shown on coumber)	rawing title	S7	BURDE	N SAMPLES	TAKEN	N/A	N/	'A
5. NAME OF				14. TOTAL					
6. DIRECTION	OF HOLF			15. ELEVAT	ION GROUI				
VERTICAL		п	DEG. FROM VERT	16. DATE	HOLE	STAR	TED	COMPLETED	
7 THICKNESS	OF OVERBURDE			17. ELEVAT	ION TOP C	OF HOLE		5-24-	.95
	LLED INTO ROCK		 	18. TOTAL	CORE REC	OVERY FOR	BORING		
9. TOTAL DEF	TH OF HOLE O	25 feet	-	19. SIGNAT	URE OF IN	ISPECTOR			
			CLASSIFICATION OF MATERIAL	5	~ 2022			251112112	
ELEVATION	DEPTH LEGEN		(Description)		% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tim	REMARKS e, water loss, e, etc. if signif	depth of icant)
0	0.0_000	Finis	shed top surfac	e		S7			
		ପ							\vdash
-0.25	0.25	EOB (0.25-ft						\vdash
		Tomas		' 0					-
		White	ed at joint 7/	8 luct					
		on	paste surface	iuct					<u> </u>
		0-0.2	is highly						<u> </u>
		fra	actured						\vdash
).25' is rubble 2-in max. size	:					-
			cural/ crushed	T.c CA					\vdash
		Natur	cal Ls FA	DS CA					\vdash
		Numer	cous entrapped	voids					⊢
	1		entrained						\vdash
		NO SE	egregation						F
		CTD #	950372						-
									<u> </u>
									F
									⊢
									⊢
									-
									F
									
									<u> </u>
									卜
									F
									F
					1				
									F
Ì					Ì				
									<u> </u>
									-

Figure B-12. Log for south seawall core S7

DRILL	ING LOG	DIVISION	INSTALLAT	IÓN			SHEET	_	7
1. PROJECT			10. SIZF	AND TYPE	OF BIT A	1	OF	1 SHEETS	-
	Perr	y's Victory	11. DATU	M FOR ELE	VATION SH	OWN (TBM OR M	SL)		-
2. LOCATION	(Coordinates or	Station)							
3. DRILLING	AGENCY		12. MANU	FACTURER'S	DESIGNA	TION OF DRILL			7
J. DRILLING	NOEWO I		13 TOT44	NO OF O	WEB -	DISTURBED	IMPIET	TIBBEO	4
4. HOLE NO.	(As shown on	drawing title		NO. OF O		i .	UNDIST	URBED	
and file (number)	S8				N/A		N/A	
5. NAME OF	DRILLER			NUMBER (]
6. DIRECTION	OF HOLF		15. ELEVA	TION GROU]
VERTICAL		DEG. FROM VERT	16. DATE	HOLE	STAF	RTED	COMPLETED		
	S OF OVERBURDE		17. FLEVA	TION TOP	DE HOLE		5-2	24-95	1
	ILLED INTO ROCK			CORE REC		R BORING			┨
				TURE OF H					┨
9. IUIAL DEI	PTH OF HOLE 1								
ELEVATION	DEPTH LEGEN	CLASSIFICATION OF MATERIA	ALS	% CORE RECOV- ERY	BOX OR	/=	REMARKS		1
		(Description)		ERY	SAMPLE NO.	(Drilling tim weathering	e, water io:	ss, depth of	
0	0.0	Finished top surfa	ce		S8				+-
	Be we to	%							\vdash
	800								\vdash
		C/S							-
	7.09								L
		8.							L
	\@@&	7							Г
	-0,00	⋛ c∕s				i			\vdash
	5000	₩ C/S		l					
	800	Name of the second seco							\vdash
		() ()							\vdash
		56		1					-
	ිට 8								<u> </u>
						ļ			L
	- KBS	à				İ			L
		6 9							
-1.55	1.55	EOB 1.55-ft New							L
									L
	⊢	Located near joint	7/8						L
	-	1 1/2-in max. size							L
		crushed/ natural	Ls CA						
		Natural Ls FA	*****						
Í		Numerous entrapped Air entrained	volds						
		No segregation							\vdash
									-
	7	CTD #950373							\vdash
									<u> </u>
	7								-
j	\dashv	1						ĺ	L
ļ	\dashv			[L
	-								L
									L
ŀ	_								
									_
									<u> </u>
İ	_]								\vdash
	٦								-
-	\dashv								<u> </u>
									L

Figure B-13. Log for south seawall core S8

DRILLI	NG LO	G	DIVISION	NAD	INSTALLATIO	N			SHEET 1 OF 1 SHEETS]
1. PROJECT	P	errv	's Vict	orv	10. SIZE A	ND TYPE O	F BIT 4	II HOWN (TBM OR MS	•	
2. LOCATION	(Coording	ites or	Station)	, <u>, , , , , , , , , , , , , , , , , , </u>						
3. DRILLING A	GENCY				12. MANUF	acturer's	DESIGNA	TION OF DRILL		
					13. TOTAL			DISTURBED	UNDISTURBED	1
4. HOLE NO. and file n		n on d	rawing title	S16	BURDEI	SAMPLES	TAKEN	N/A	N/A	
5. NAME OF					14. TOTAL]
6. DIRECTION	OF HOLE				15. ELEVAT	ION GROUN		RTED	COMPLETED	┨
VERTICAL			o	DEG. FROM VERT	16. DATE I	OLE			5-24-95	
7. THICKNESS			1		17. ELEVAT			0.00000		1
8. DEPTH DRI					18. TOTAL 19. SIGNAT					┨
9. TOTAL DEP	TH OF H	DLE O.]
ELEVATION	DEPTH	LEGEN		CLASSIFICATION OF MATERIAL (Description)	S	% CORE RECOV- ERY	BOX OF SAMPLE NO.	(Drilling time	REMARKS e, water loss, depth of , etc. if significant)	
0	0.0	SS 80	Finis	shed top surfac	e		S16			
		800	Ž.							
	_	900	0.00							
-0.35	0.35	S. CD-55	EOB C).35-ft						L
	_					:				_
			Locat	ed near joint				i		-
	_			'is highly					•	┝
	_			ctured						
				0.35' is rubble max. size crus				:		┢
				ural Ls CA	illed/					
	_			al Ls FA						
		ļ		entrapped void entrained	ls					L
				gregation						L
										⊢
	_		CTD #	950374				ŀ		⊢
	_									┝
								ŀ		
										┌
	_		,					1		
	_									L
	_									L
	_						İ			-
		1								\vdash
	_	1								 -
										<u> </u>
]						1		r
	_									\vdash
	_	1		-						-
		1								-
		<u> </u>								上

Figure B-14. Log for south seawall core S16

DRILL	ING LOG	DIVISION	NAD	INSTALLAT	ÓИ			SHEET	1
1. PROJECT			NAD	10. SIZE /	ND TYPE	DE DIT 4 H		OF 1	SHEETS
		y's Vict	tory				OWN (TBM OR M	SL)	
2. LOCATION	(Coordinates or	Station)							
3. DRILLING	AGENCY			12. MANU	ACTURER'S	DESIGNAT	ION OF DRILL		
				13. TOTAL	NO. OF O	VER-	DISTURBED	UNDISTU	RBED
4. HOLE NO.	(As shown on	drawing title	S16/17	BURDE	N SAMPLES	TAKEN	N/A		N/A
5. NAME OF				14. TOTAL	NUMBER C	ORE BOXE		1	N/A
				15. ELEVAT					
6. DIRECTION		_		16. DATE	HOI F	STAR	TED	COMPLETED	
VERTICAL			DEG. FROM VERT					5-24	1-95
	S OF OVERBURDE			17. ELEVAT			RORING		
				19. SIGNAT					
9. TOTAL DET	PTH OF HOLE O		NACCIFICATION OF MATERIAL						
ELEVATION	DEPTH LEGEN		CLASSIFICATION OF MATERIAL (Description)	.5	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tim weathering	REMARKS e, water loss e. etc. if sign	, depth of
0	0.0_8	Finis	shed top surfac	е		S16			
	8 5	3	_						-
		(C)							
									<u> </u>
	al.	3							
		8							····
	8,59	Ĭ							
-0.7	0.70	EOB 0).7-ft						F
		* •		4					
		Locat	ed at joint 16	/17					
		S17 (portion) intac	t					
	_	1-in	max. size crus						Г
	-		ural Ls CA						
	-		al Ls FA ous entrapped						
		Air e	ntrained	voids					
	_		gregation						L
	i								L
·	-	S16 (portion)	- 3					L
	-		cal & horizont: ctures through						L
			und aggregates	and					
		No or	little entrais	ned		l			L
	-	air	ambaanna a di ad				•		L
	-		entrapped air gregation	Ì					L
	-	Aggre	gate like S17						<u> </u>
-									
	-	CTD #	950375						L
	-				İ				-
İ	4								<u> </u>
	7								-
									<u> </u>
									<u> </u>
	7								_
	7								_
	7					ĺ			-
					ļ	ľ			
		1							⊢

Figure B-15. Log for south seawall core S16/17

										~
DRILLI	NG LO	3	DIVISION	NAD	INSTALLATIO)N			SHEET 1 OF 1 SHEETS	
1. PROJECT	D	orm	's Vict	orv	10. SIZE A			OWN (TBM OR MS		1
2. LOCATION				COLY						
3. DRILLING A	AGENCY				12. MANUF	acturer's	DESIGNAT	ION OF DRILL		
					13. TOTAL			DISTURBED	UNDISTURBED	1
4. HOLE NO. and file n		n on de	awing title	S17A	BURDE	SAMPLES	TAKEN	N/A	N/A	
5. NAME OF					14. TOTAL			S]
6. DIRECTION	OF HOLE		-	, , , , , , , , , , , , , , , , , , ,	15. ELEVAT	ION GROUN	D WATER	TED	COMPLETED	┨
VERTICAL			o	DEG. FROM VERT	16. DATE I	IOLE			5-24-95	
7. THICKNESS					17. ELEVAT			PORING		}
8. DEPTH DRI					19. SIGNAT			DORING		1
9. TOTAL DEP	TH OF H	DTE 0		CLASSIFICATION OF MATERIAL	•	~		1	REMARKS	-
ELEVATION	DEPTH	LEGEN		(Description)	۵ .	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling time	e, water loss, depth of , etc. if significant)	
0	0.00			shed top surfac	e		S17A			L
	_		Rubb]	le ced at joint 17	/18					L
	-		Some	vertical crack	:s					H
	_			rough and aroun	ıd					F
		1	1 1/2	2-in max. size						
	-		nat	tural crushed I	s CA					卜
				ral Ls FA	l					
				entrapped void entrained void						
			No se	egregation						L
	_		CTTD ±	‡950376						
	-			733373						\vdash
	-									\vdash
		}					}			
	_									
	_	ļ								L
	-	ļ								F
	_	1								\vdash
										\vdash
	-	1								
							1]		
,	_	1								
	-	-								\vdash
	-	1								\vdash
	-	1								-
	_	1								\vdash
	_	1								
	-	1								_
•	-	-								\vdash
	-	1								\vdash
		-					<u> </u>			-

Figure B-16. Log for south seawall core S17A

1. PROJECT Perry's Victory 1. DATUM FOR ELEVATION SHOWN (TBM OR MSL) 1. DATUM FOR ELEVATION SHOWN (TBM OR MSL) 1. DATUM FOR ELEVATION SHOWN (TBM OR MSL) 1. DATUM FOR ELEVATION SHOWN (TBM OR MSL) 1. DATUM FOR ELEVATION SHOWN (TBM OR MSL) 1. DATUM FOR ELEVATION OF DRILL 1. DATUM FOR ELEVATIO	
2. LOCATION (Coordinates or Station) 12. MANUFACTURER'S DESIGNATION OF DRILL 13. TOTAL NO. OF OVER—BURDEN SAMPLES TAKEN 14. HOLE NO. (As shown on drawing title and file number) 15. NAME OF DRILLER 16. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT 17. THICKNESS OF OVERBURDEN 18. DEPTH DRILLED INTO ROCK 19. TOTAL DEPTH OF HOLE 1.2 feet ELEVATION DEPTH LEGEND 10. 0. 00 Finished top surface 12. MANUFACTURER'S DESIGNATION OF DRILL 13. TOTAL NO. OF OVER—BURDED UNDISTURBED N/A N/A N/A N/A N/A N/A N/A N/	EETS
3. DRILLING AGENCY 4. HOLE NO. (As shown on drawing title and file number) 5. NAME OF DRILLER 6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT 7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1, 2 feet 13. TOTAL NO. OF OVER-BURDEN BURDEN SAMPLES TAKEN N/A N/A 14. TOTAL NUMBER CORE BOXES 15. ELEVATION GROUND WATER 16. DATE HOLE STARTED COMPLETED 5-24-95 17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR 19. SIGNATURE OF INSPECTOR 19. SIGNATURE OF INSPECTOR 10. O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
4. HOLE NO. (As shown on drawing title and file number) 5. NAME OF DRILLER 6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT 7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1.2 feet ELEVATION DEPTH LEGEND CLASSIFICATION OF MATERIALS (Description) CLASSIFICATION OF MATERIALS (Description) DEG. FROM VERT 14. TOTAL NUMBER CORE BOXES 15. ELEVATION GROUND WATER 16. DATE HOLE STARTED COMPLETED 5 - 24 - 95 17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR REMARKS (Drilling time, water loss, dept weathering, etc. if significant weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dep	
ond file number) 5. NAME OF DRILLER 14. TOTAL NUMBER CORE BOXES 15. ELEVATION GROUND WATER 6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT 7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1.2 feet ELEVATION CLASSIFICATION OF MATERIALS (Description) CLASSIFICATION OF MATERIALS (Description) Finished top surface N/A N/A N/A N/A N/A N/A N/A N/	
5. NAME OF DRILLER 14. TOTAL NUMBER CORE BOXES 15. ELEVATION GROUND WATER 6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT 16. DATE HOLE 7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1.2 feet CLASSIFICATION OF MATERIALS (Description) 14. TOTAL NUMBER CORE BOXES 15. ELEVATION GROUND WATER 5-24-95 17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR REMARKS (Drilling time, water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept weathering, etc. if significant water loss, dept water loss,	
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT 16. DATE HOLE STARTED COMPLETED 5-24-95 7. THICKNESS OF OVERBURDEN 17. ELEVATION TOP OF HOLE 8. DEPTH DRILLED INTO ROCK 18. TOTAL CORE RECOVERY FOR BORING 9. TOTAL DEPTH OF HOLE 1.2 feet 19. SIGNATURE OF INSPECTOR ELEVATION DEPTH LEGEND CLASSIFICATION OF MATERIALS % CORE RECOVERY FOR BOX OR REMARKS (Description) (Description) % CORE RECOVERY FOR BOX OR REMARKS (Description) % CORE RECOVERY FOR BOX OR REMARKS (DESCRIPTION OF MATERIALS RECOVERY FOR BOX OR REMARKS (DESCRIPTION OF MATERIALS RECOVERY FOR BOX OR REMARKS (DESCRIPTION OF MATERIALS RECOVERY FOR BOX OR SAMPLE NO. (DESCRIPTION OF MATERIALS RECOVERY FOR BOX OR SAMPLE NO. (DESCRIPTION OF MATERIALS NO.	
VERTICAL DINCLINED DEG. FROM VERT 16. DATE HOLE 5-24-95 7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1.2 feet CLASSIFICATION OF MATERIALS (Description) CLASSIFICATION OF MATERIALS (Description) 7. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR REMARKS (Drilling time, water loss, dept weathering, etc. if significant weathering, etc. if significant	
7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1.2 feet CLASSIFICATION OF MATERIALS (Description) 17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING 19. SIGNATURE OF INSPECTOR REMARKS (Drilling time, water loss, dept weathering, etc. if significant significant) O 0.00 Finished top surface S17B	İ
9. TOTAL DEPTH OF HOLE 1.2 feet SIGNATURE OF INSPECTOR 19. SIGNATURE	
9. TOTAL DEPTH OF HOLE 1.2 feet ELEVATION DEPTH LEGEND CLASSIFICATION OF MATERIALS (Description) Z CORE SAMPLE (Drilling time, water loss, dept weathering, etc. if significant significant S17B	
ELEVATION DEPTH LEGEND (Description) RECOV- SAMPLE NO. (Drilling time, water loss, dept weathering, etc. if significant signi	
0 0.00 Finished top surface S17B	n of
	()
Hairline crack to 1 in	<u> </u>
depth through aggregate	
C/s	
	L
	_
-1.2 1.20 EOB 1.2 New	
Located at joint 17/18 1 1/2-in max. size	
natural/ crushed Ls CA	
Natural Ls FA	_
Numerous entrapped voids Air entrained	\vdash
No segregation	-
CTD #050377	
CTD #950377	-
	_
	-
	_
	上

Figure B-17. Log for south seawall core S17B

DRILLI	NG LOC	3 1	IVISION	NAD	INSTALLATIO	N			SHEET 1 OF 1 SHEETS]
1. PROJECT					10. SIZE A	ND TYPE C	F BIT 4	11		1
2. LOCATION	Coording	erry	s Vict	cory	11. DATUM	FOR ELEV	ATION SH	IOWN (TBM OR M	SL)	
					12. MANUF	ACTURER'S	DESIGNA	TION OF DRILL		1
3. DRILLING	GENCY				13. TOTAL	NO. OF.O\	/ER-	DISTURBED	UNDISTURBED	1
4. HOLE NO.		n on dr	awing title	S20		SAMPLES		N/A	N/A	
and file n				2.00	14. TOTAL	NUMBER C	ORE BOX			1
	05 11015				15. ELEVAT	ION GROUN		RTED	Looverse	1
6. DIRECTION VERTICAL				DEG. FROM VERT	16. DATE I			KILD	5-24-95	
7. THICKNESS					17. ELEVAT			D BOBING		}
8. DEPTH DRI		-			19. SIGNAT					1
9. TOTAL DEP	TH OF HO	DLE () . :								
ELEVATION	DEPTH	LEGEND		CLASSIFICATION OF MATERIAL (Description)	S	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling tin	REMARKS ne, water loss, depth of ig, etc. if significant)	
0	0.00		Finis	shed top surfac	е		S20			F
-0.2	0.20	V.A.V.	EOB (0.2-ft						
	_]	Locat	ted at joint 19	/20					F
			Rubb.	le						
	_			rous entrapped entrained void						H
				filled entrain						
				ids						
			Fract	tures through a ound CA	nd					
	_		1-in	max. size natu	ral/					L
	_		cr	ushed Ls CA						-
	-		Natu:	ral Ls FA						\vdash
	_		CTD :	#950379						-
								,		
	_]								r
]	Petro	ography - White	:					
	_			action was tringite						
				cringice				1		
	-									\vdash
	-	1								\vdash
	-				٠					-
	_									-
		1	1					-		
	_					1				
	_							İ		F
	_]				1				
	_									
}				•		}				
	-	4								-
			4							

Figure B-18. Log for south seawall core S20

DRILL	ING LOG	DIVISION	NAD	INSTALLAT	ION			SHEET 1	
1. PROJECT	_	•		10. SIZE	AND TYPE	OF BIT 4	н	OF 1 s	HEETS
2 LOCATION	(Coordinates or	y's Vict	cory	11. DATU	FOR ELE	VATION SH	OWN (TBM OR M	SL)	
		Sidilolly		12. MANU	FACTURER'S	DESIGNA	TION OF DRILL		
3. DRILLING	AGENCY			47 70711	110 05 0		DICTURDED		
4. HOLE NO.	(As shown on	trawing title	000		NO. OF O		DISTURBED	UNDISTURBED	
and file			S27	44 70711			N/A	N/A	
5. NAME OF	DRILLER				NUMBER (
6. DIRECTION	OF HOLE				• `		RTED	COMPLETED	
VERTICAL	INCLINED	0	DEG. FROM VERT	16. DATE				5-24-9	5
	S OF OVERBURDE				CORE REC		0.00000		
	ILLED INTO ROCK				TURE OF IN		R BORING		
9. TOTAL DE	PTH OF HOLE 1								
ELEVATION	DEPTH LEGEN		CLASSIFICATION OF MATERI	ALS	% CORE RECOV-	BOX OR SAMPLE	(Dailling time	REMARKS	
	2220		(Description)		ERY	NO.	Weathering	e, water loss, dep , etc. if significa	th of nt)
0	0.00 68	Finis	shed top surfa	.ce		S27		,	
		thr	oict fractures cough and arou	nd CA					
			ough dha alou	iiu ca					
	- 600				İ				
		3.] :C							<u> </u>
	- 25	3				i			L
	- 600								\vdash
		S S					1		
	_ 8300	9 0/0							-
		C/S			ļ		1		-
	884	9							-
		3					i		-
	- 200 C	0.							-
									-
-1.5	1.50	EOB 1	.5 New						
		Locat	ed at joint 2 - in max. size	7/28					_
	_		ural/ crushed						
		Natur	al Ls FA						
	_		ous entrapped						
	_		entrained air gregation			•			
		110 50	gregacion						
		CTD #	950378						
	_								
	-								_
									_
	_								-
									-
	***************************************								_
									-
									F
									F
									一
					İ				
		L							\vdash

Figure B-19. Log for south seawall core S27

									_
DRILLI	NG LOG	DIVISION	NAD	INSTALLATIO	ON			SHEET 1 OF 1 SHEETS	
1. PROJECT				10. SIZE A	ND TYPE C	F BIT 4"			1
0 100171011	Perry (Coordinates or	y's Vict	ory	11. DATUM	FOR ELEV	ATION SHO	WN (TBM OR MS	L)]
2. LUCATION	(Coordinales of	Sidilony		12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL		1
3. DRILLING	AGENCY						,]
4 HOLE NO	(As shown on e	trawing title		13. TOTAL BURDE	NO. OF ON N SAMPLES		DISTURBED	UNDISTURBED	1
and file n		adwing into	S37	DOMBE	1 JAMI LLO	IAKEN	N/A	N/A	J
5. NAME OF	DRILLER			14. TOTAL			5		
6. DIRECTION	OF HOLF			15. ELEVAT	ION GROUP	D WATER	TEN	COMPLETED	-
VERTICAL		0	DEG. FROM VERT	16. DATE I	HOLE	JIAN	100	5-24-95	
7. THICKNESS	OF OVERBURDE	N		17. ELEVAT	ION TOP C	F HOLE			1
8. DEPTH DRI	LLED INTO ROCK			18. TOTAL			BORING		
9. TOTAL DEP	TH OF HOLE 1	.25 feet	•	19. SIGNAT	UKE UF IN	ISPECTOR			1
			CLASSIFICATION OF MATERIAL	S	% CORE	BOX OR SAMPLE		REMARKS	1
ELEVATION	DEPTH LEGEN	ID	(Description)		% CORE RECOV- ERY	SAMPLE NO.	(Drilling time weathering,	e, water loss, depth of , etc. if significant)	
0	0.0_	Finis	shed top surfac	:e		S37			
		Vert:	ical crack to r	ebar		1			
	10128	0							
		्व							
]		8 7/8-	in steel reinfo	rcing					
	000		r, slightly rus						
	- 9000	Ø							
	200								
	_ &	1 00							L
	\mathred{\matrid{\matrod{\mathred{\matrod{\matrod{\matrod{\matrod{\matrod{\matred{\matrod{\matrod{	න	•			ļ			L
									L
		9							L
-1.25	1.25	EOB :	l.25-ft						L
									L
		Locat	ed at joint 37	7/38					<u></u>
	I -		2-in max. size cural/ crushed	I = C3					_
}	-		ral Ls FA	LS CA		}			L
			rous entrapped	voids					L
	_	Some	entrained air						L
		No se	egregation						\vdash
		ا ست ا	‡9503 8 0						F
	_		, , , , , , , , , , , , , , , , , , , ,						-
	-								H
	_			-					H
		Petro	ography - Fract ndurable aggreg	ured					
	_	is	a porous dolom	nitic					\vdash
			mestone						\vdash
									\vdash
}									-
									\vdash
									H
	-								\vdash
	-					İ			-
									-
						1			-
	-						1		\vdash

Figure B-20. Log for south seawall core S37

DRILL	ING LOG	DIVISION	MAD	INSTALLATI	ON				1
1. PROJECT			NAD	10. SIZE A	ND TYPE	OF RIT A		OF 1	SHEETS
		y's Vict	tory				OWN (TBM OR MS	SL)	
2. LOCATION	(Coardinates or	Station)		12 MANUE	ACTUBEDIS	DESIGNAT	TON OF DRILL		
3. DRILLING	AGENCY			12. MARGI	ACTURERS	DESIGNA	ION OF BRILL		
			<u> </u>	13. TOTAL			DISTURBED	UNDISTUR	BED
4. HOLE NO.	(As shown on a number)	drawing title	S 4 9	BURDE	N SAMPLES	5 TAKEN	N/A	N	/A
5. NAME OF			<u></u>	14. TOTAL	NUMBER (ORE BOXE	s		
6. DIRECTION	OF HOLE			15. ELEVAT	ION GROU		750		
VERTICAL			DEG. FROM VERT	16. DATE	HOLE	STAF	TED	COMPLETED 5-24	-95
7. THICKNESS	OF OVERBURDE	N		17. ELEVAT					
8. DEPTH DR	ILLED INTO ROCK			18. TOTAL 19. SIGNAT			R BORING		
9. TOTAL DEF	TH OF HOLE O	.55 feet		19. SIGNA	UKE OF IP	SPECIOR			
5.5.4.7.0.1	DERTH 1505)		CLASSIFICATION OF MATERIAL	S	% CORE	BOX OR SAMPLE		REMARKS	
ELEVATION	DEPTH LEGEN	D	(Description)		% CORE RECOV- ERY	SAMPLE NO.	(Drilling time	e, water loss, , etc. if signi	depth of ficant)
0	0.00	Finis	shed top surfac	e		S49			
		D. C.	_						
		8							
	200	2							
		0							
-0.55	0.55	FOR C).55-ft						
-0.55	0.55	LOB	7.55-LC						
		Locat	ed at joint 48	/49					
ĺ		Numer	cous incipient						
			cks through						
	4	1 1 /2	gregate and pas 2-in max. size	te					
	_		ural/ crushed	Ls CA					
	l		cal Ls FA						L
			entrapped air			İ			L
			entrained air reaction arou	nd Ca					
	-	1111111	: reaction arou	iid CA					
	\vdash	CTD #	950381						
	\vdash								
	-								ļ
		Petro	graphy - Acid						
	-	eto	hed of reactio	n					–
	-	rin	as shows no cha	nge					_
	-	l in	relief						-
	-								-
									-
									-
									-
									-
									<u> </u>
	-								-
	1								
									-
	7								-
									·
									-
									\vdash

Figure B-21. Log for south seawall core S49

DRILLI	NG LOG	DIVISION	NAD	INSTALLATIO	N			SHEET 1 OF 1 SHEETS	7
1. PROJECT	Perr	y's Vict	orv	10. SIZE A			OWN (TBM OR MS		7
2. LOCATION	(Coordinates or	Station)		L			TION OF DRILL		4
3. DRILLING	AGENCY		·				DISTURBED	LINDICTURGO]
	(As shown on	drawing title	S52A	13. TOTAL BURDE	NO. OF OV		N/A	UNDISTURBED N/A	
and file n			2001	14. TOTAL	NUMBER C	ORE BOXE		N/A	_
			 	15. ELEVAT	ION GROUN]
6. DIRECTION VERTICAL		o	DEG. FROM VERT	16. DATE	HOLE	STA	RTED	5-24-95	
7. THICKNESS	OF OVERBURDE	N		17. ELEVAT	ION TOP O	F HOLE]
8. DEPTH DRI	LLED INTO ROCK			18. TOTAL			R BORING		_
9. TOTAL DEP	TH OF HOLE O	25 feet		19. SIGNAT	URE OF IN	SPECTOR			
			CLASSIFICATION OF MATERIAL	\$	% CORE	BOY OR	1	REMARKS	-
ELEVATION	DEPTH LEGEN		(Description)		RECOV- ERY	BOX OR SAMPLE NO.		e, water loss, depth of , etc. if significant)	
0	0.00	Finis	shed top surfac	e		S52A			
		79				1			\vdash
-0.25	0.25	EOB a	approx. 0.25-ft	•					-
	l								\vdash
			ed at joint 51	./52					\vdash
	-	Rubbl							\vdash
	_		onal incipient actures through	,					_
	-		gregate and pas						
			rous entrapped						L
		Some	entrained air						
			white reaction	1					
			oduct in voids		1				L
	_		2-in max. size cural/ crushed	T.G. CD					L
			ral Ls FA	IIS CA		1			L
		CTD #	\$950382						
									Г
		Potro	ography - Many	woids					
		Wei	re filled with	voius					
			ringite						
						1			
							1		_
							1		-
	ı i								\vdash
									-
					1				\vdash
									-
	-								-
	-								\vdash
	_								\vdash
	-								\vdash
									-
		1							1

Figure B-22. Log for south seawall core S52A

DRILLI	ING LOC	; T	DIVISION	NAD	INSTALLATI	ON		· · · · ·	SHEE	-	1	7
1. PROJECT					10. SIZE A	ND TYPE	OF BIT 4 1	ı	OF	_1_	SHEET	<u>s</u>
2. LOCATION	Coording	erry	's Vict	ory	11. DATUM	FOR ELEV	ATION SH	OWN (TBM OR MS	SL)			
2. LOCATION	(Coordina	162 01	Jidiion)		12. MANU	ACTURER'S	DESIGNAT	TION OF DRILL				\dashv
3. DRILLING	AGENCY											
4. HOLE NO.	(As shows	n on di	awing title	0500	13. TOTAL BURDE	NO. OF O' N SAMPLES		DISTURBED	UND	STURE	BED	
and file n	umber)		•	S52B				N/A		N,	/A	
5. NAME OF	DRILLER				14. TOTAL 15. ELEVAT			s				_
6. DIRECTION	OF HOLE						STAF	TED	COMPLET	ED		-
VERTICAL	□ INC	LINED	o	DEG. FROM VERT	16. DATE				5.	-24	-95	
7. THICKNESS					17. ELEVAT			2 800000				7
8. DEPTH DRI					19. SIGNAT			BURING				\dashv
9. TOTAL DEP	TH OF HO	Œ 1										
ELEVATION	DEPTH	LEGEND		(Description)	S	% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling time	REMARKS e, water , etc. if		depth of	ſ
0	0.00	12 2 C	Finis	hed top surfac	е		S52B				,	\top
	_	800	Petro	graphy								\vdash
	_ <u>₹</u>	50E	3				•					
		860rg										
			bar	steel reinforc	ing							
	_	20.00	C/S					ŀ				
	_	300										
	_ 6	0000	<u> </u>									L
			2									L
-1	1.00		EOR 1	.0-ft new								<u> </u>
/ -			DOD 1	.o ic new								- -
			Locat	ed at joint 51	/52							\vdash
				<pre>-in max. size ural/ crushed :</pre>	T							\vdash
				al Ls FA	LS CA							
			Some	entrapped air								
1	4		Air e	ntrained								
	-		CTD #	950383								
İ	-											_
	\dashv											\vdash
			Petro	graphy - Acid								\vdash
			etc	hed indicated	some							\vdash
			neg	ative reaction	rims							\vdash
	4]			-						
	4											
												L
	4											L
	4											
	4											\vdash
	-											<u> </u>
												-

Figure B-23. Log for south seawall core S52B

DRILLI	NG LOG	DIVISION	MAD	INSTALLATIO	N			SHEET 1	7		
1. PROJECT			10. SIZE A	OF 1 SHEETS	-						
Perry's Victory 2. LOCATION (Coordinates or Station)			11. DATUM FOR ELEVATION SHOWN (TBM OR MSL)								
2. LOCATION (Coordinates or Station)			12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL		┨			
3. DRILLING AGENCY						Lalazuasa		1			
4. HOLE NO.	(As shown on	drawing title	2004	13. TOTAL BURDEI	NO. OF ON SAMPLES		DISTURBED	UNDISTURBED			
and file n	umber)	•	S60A		,		N/A	N/A	-		
5. NAME OF	DRILLER			14. TOTAL 15. ELEVAT			S		4		
6. DIRECTION				16. DATE		STAR	TED	COMPLETED	1		
VERTICAL			DEG. FROM VERT	5-24-95							
7. THICKNESS OF OVERBURDEN 8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING							
				19. SIGNAT					1		
9. TOTAL DEP	TH OF HOLE O		CLASSIFICATION OF MATERIAL		* CODE	DOY OD		REMARKS	-		
ELEVATION	DEPTH LEGEN		(Description)		% CORE RECOV- ERY	BOX OR SAMPLE NO.		, water loss, depth of etc. if significant)			
0	0.0	Finis	shed top surfac	e		S60A					
	-9.50	7.5] 5.6]				ļ			L		
•	_600	8									
		S							\vdash		
-0.5	0.50	EOB (0.5-ft						-		
0.5	0.50								\vdash		
			ed at joint 59	/60							
			ical incipient acture								
			2-in max. size								
}		nat	cural/ crushed	Ls CA							
			ral Ls FA e reaction prod	luct							
	-	aro	ound CA	idel							
:			entrapped air						\vdash		
			entrained air egregation						\vdash		
			-33						\vdash		
		CTD :	‡95038 4								
			•								
	-		ography - White action product						-		
			R associated wi						\vdash		
			w index chert						\vdash		
						1			H		
									L		
									<u></u>		
	-								-		
	-								-		
			•						-		
			•						 		

Figure B-24. Log for south seawall core S60A

DRILLING LOG DIVISION NAD			INSTALLATION SHEET						1		7				
1. PROJECT			10. SIZE AND TYPE OF BIT 4 H							SHEET	<u>s</u>				
Perry's Victory				11. DATUM FOR ELEVATION SHOWN (TBM OR MSL)								\neg			
2. LOCATION (Coordinates or Station)					12	MANU	FACTURER	. DEG	ICMAT	TON OF DOIL					_
3. DRILLING AGENCY					12. MANUFACTURER'S DESIGNATION OF DRILL										
4. HOLE NO. (As shown on drawing title					13.		NO. OF O			DISTURBED		UNDIST	URBE	D	
and file number) S60B				BURDEN SAMPLES TAKEN N/A N/A											
5. NAME OF	DRILLER						NUMBER (S					
6. DIRECTION	OF HOLF				15.	ELEVA	TION GROU	ND W		750	1				
VERTICAL			o	DEG. FROM VERT	16. DATE HOLE STARTED COMPLETED 5-24-95										
					17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING										
8. DEPTH DR	ILLED INTO	ROCK			_		CORE REC			BORING					
9. TOTAL DE	TH OF HO	DLE 1.	1 feet		""	DIOITA	IONE OF R	131 [[NON						
ELEVATION	DEPTH	LEGEN		LASSIFICATION OF MATERIAL	S		% CORE	80	X OR		REMA				
ELEVATION	DEFIN	LEGEN	<i>y</i>	(Description)			% CORE RECOV- ERY	SAI	MPLE 10.	(Drilling time weathering	e, wat	er los if sig	s, d nifi	epth c	£ .
0	0.0_	800	Finis	hed top surfac	е			Se	0B						
	1 -		Verti	cal incipient											
	-		fra	ctures through	_										L
		APO ES	out	length of cor	е										L
		50	(th	rough CA parti	cle	es)		ĺ							
	1 -	obole.	o												L
		p.99	3												
															
	-	300	t												L
			2					ĺ							
-1.1	1.10	30 34	EOB 1	1 _ f+											-
	1		BOD 1	.1-10											-
			Locat	ed at joint 59	/60)									\vdash
	ΙŢ			-in max size	_										-
				ural/ crushed al Ls CA	Ls	CA									\vdash
				entrapped air											-
			Some	entrained air											-
				white reaction											\vdash
			pro	ducts in voids											\vdash
			CTD #	950385											
			"												\vdash
															
			Detro	amanha a	_										\vdash
				graphy - Coarse regate particle											\vdash
				porous	=5										
				•											\vdash
	_														
	4														
	_														
	\dashv														
			1												_

Figure B-25. Log for south seawall core S60B

		Landelon		INICTALLATIO	141			curer 1	7			
DRILLI	NG LOG	DIVISION	NAD	INSTALLATIO				SHEET 1 OF 1 SHEETS]			
1. PROJECT Perry's Victory			10. SIZE AND TYPE OF BIT 4 " 11. DATUM FOR ELEVATION SHOWN (TBM OR MSL)									
2. LOCATION (Coordinates or Station)				12. MANUFACTURER'S DESIGNATION OF DRILL								
3. DRILLING AGENCY												
A HOLE NO	(As shown on	drawing title		13. TOTAL BURDEI	NO. OF OV SAMPLES		DISTURBED	UNDISTURBED				
and file n	umber)	didning init	S68		N/A N/A 14. TOTAL NUMBER CORE BOXES							
5. NAME OF	DRILLER			15. ELEVAT					┨			
6. DIRECTION				16. DATE I			RTED	COMPLETED	1			
VERTICAL			DEG. FROM VERT		5-24-95	-						
	OF OVERBURDI			17. ELEVATION TOP OF HOLE 18. TOTAL CORE RECOVERY FOR BORING								
8. DEPTH DRILLED INTO ROCK 9. TOTAL DEPTH OF HOLE 1.4 feet					URE OF IN	SPECTOR			1			
9. IUIAL DEF	IN OF HOLE 1		CLASSIFICATION OF MATERIAL	S	% CORF	BOX OR	1	REMARKS	┨			
ELEVATION	DEPTH LEGE		(Description)		% CORE RECOV- ERY	BOX OR SAMPLE NO.	(Drilling time	e, water loss, depth of , etc. if significant)				
0	0.0	Finis	shed top surfac	e		S68						
10	_600	o.b 29							L			
	_\0\g	C/S	•						_			
							ĺ		\vdash			
		CAP C							_			
	bood	0							-			
	- 200	0.6							-			
	- 62	980							\vdash			
	- 30								-			
		0		,					\vdash			
		9							\vdash			
									\vdash			
		87										
-1.4	1.40	EOB :	1.4-ft new									
	-	Locat	ted near mid-le	ength					_			
		of	monolith	_					-			
	-		2-in size natur	ral/					\vdash			
	-		ushed Ls CA ral Ls FA						\vdash			
			entrapped air		1							
		Air	entrained			1						
		No s	egregation									
		CTD :	#950386									
					1							
1									L			
									_			
							1		-			
									-			
1	-								+			
	-								\vdash			
	-								\vdash			
									-			
							1					

Figure B-26. Log for south seawall core S68

DRILLING LOG DIVISION NATIO			INSTALLATION SHEET 1									
IAD				OF 1 SHE								
1. PROJECT Perry's Victory				10. SIZE AND TYPE OF BIT 4-in 11. DATUM FOR ELEVATION SHOWN (TBM OR MSL)								
2. LOCATION	(Coordinates or	Station)		Ī					_			
3. DRILLING A	AGENCY			12. MANUF	ACTURER'S	DESIGNAT	ION OF DRILL					
3. BRILLING AGENCY					13. TOTAL NO. OF OVER- DISTURBED UNDISTURBED							
4. HOLE NO. (As shown on drawing title \$72					BURDEN SAMPLES TAKEN							
and file number) 5. NAME OF DRILLER					14. TOTAL NUMBER CORE BOXES							
				15. ELEVAT	ION GROUP				_			
6. DIRECTION		-	DEC FROM MEST	16. DATE	HOLE	STAR	TED	COMPLETED	7			
VERTICAL			DEG. FROM VERT	17. ELEVATION TOP OF HOLE								
	LLED INTO ROCI			18. TOTAL			BORING		1			
				19. SIGNAT	URE OF IN	SPECTOR			1			
9. TOTAL DEF	TH OF HOLE 1		CLASSIFICATION OF MATERIA	15	~ cons	BOY OD		REMARKS	4			
ELEVATION	DEPTH LEGE		(Description)		% CORE	BOX OR SAMPLE	(Drilling tim	e, water loss, depth of g, etc. if significant)				
	70.V.C	~			ERY	NO.	weathering	g, etc. if significant)	+			
0	0.0		shed top surfac rous incipient	ce		S72			\vdash			
	- 000		actures						-			
	-00	6							\vdash			
	- 000								\vdash			
	5000		forcing steel 8	Šc.					\vdash			
			e wire, some rrosion						\vdash			
	− j ∂	0.0	11051011						\vdash			
	- 69	C/S							\vdash			
	- 38	Shor	t specimen						-			
									-			
		ž.							\vdash			
	−¦}_2	Rein	forcing steel,						-			
	-\%		me corrosion		1				\vdash			
-1.4	1.4	EOB .	1.4-ft new			}			\vdash			
1.1	* . *	100	1.4 10 MCW						-			
	_	Locat	ted at joint 72	2/73					\vdash			
			size natural/						\vdash			
	1 7		ushed Ls CA ral Ls FA						H			
			rous entrapped	voids								
			entrained					•				
		No se	egregation									
		Cum 4	#950387		į							
		1 (11)	m > 3 0 3 0 7									
									L			
									L			
		-							L			
									L			
									_			
									L			
		ļ							_			
									_			
									-			
									\vdash			
							i .					

Figure B-27. Log for south seawall core S72

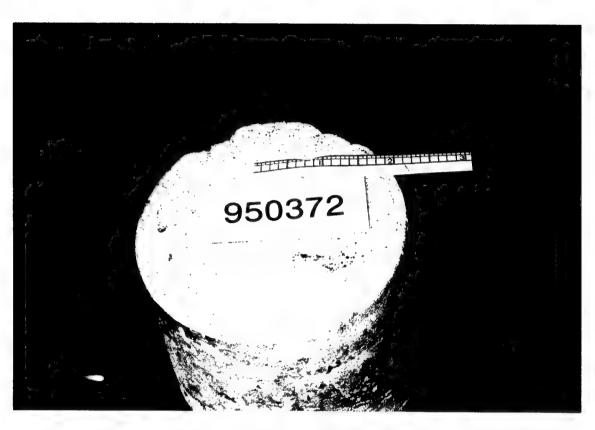


Figure B-28. Sample 950372 surface shows intact concrete



Figure B-29. Cracking parallel to top surface of structure (bottom of photo) occurs several inches below surface and cannot be detected by visual examination

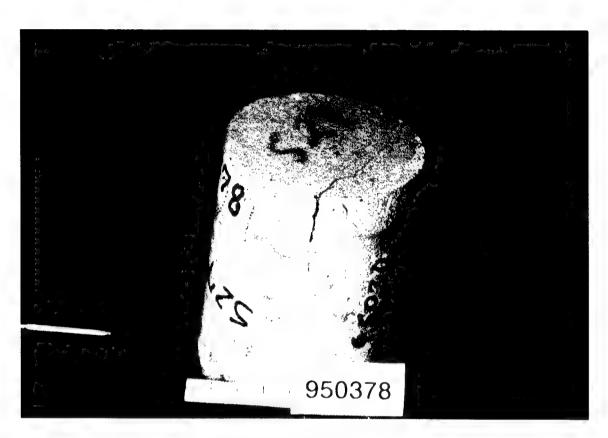


Figure B-30. Vertical crack in sample 950378 goes to the surface of the concrete

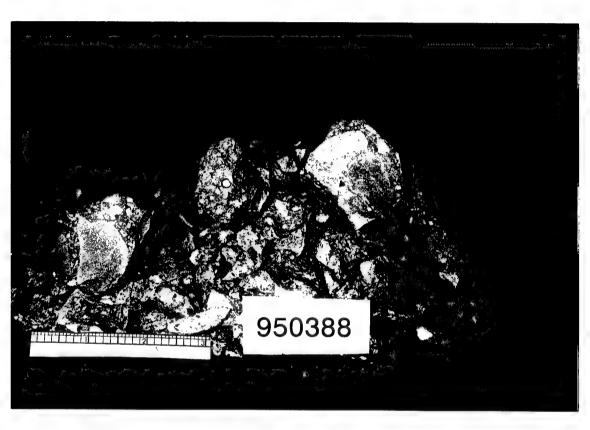


Figure B-31. Sample 950388 consists of rubble in which the fractures commonly go through aggregate particles as well as through paste

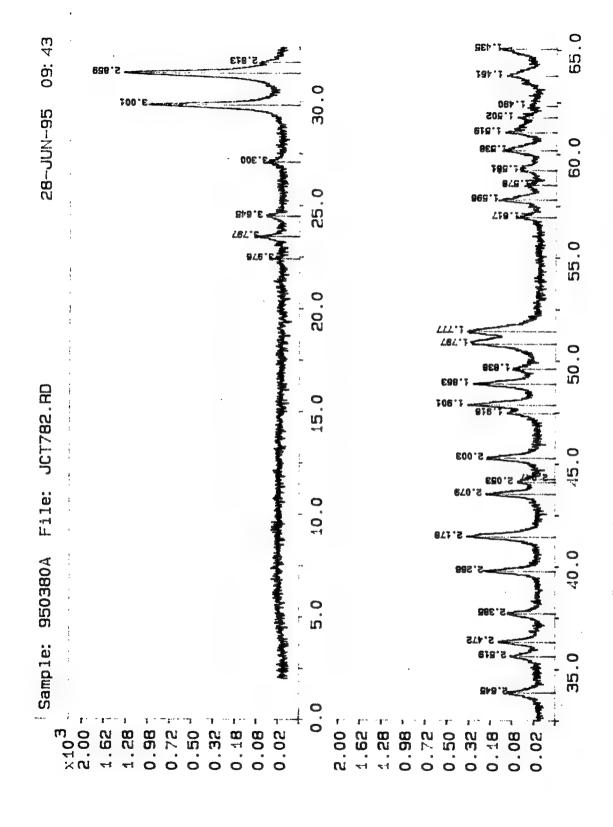


Figure B-32. X-ray diffraction patterns for Sample 950380A

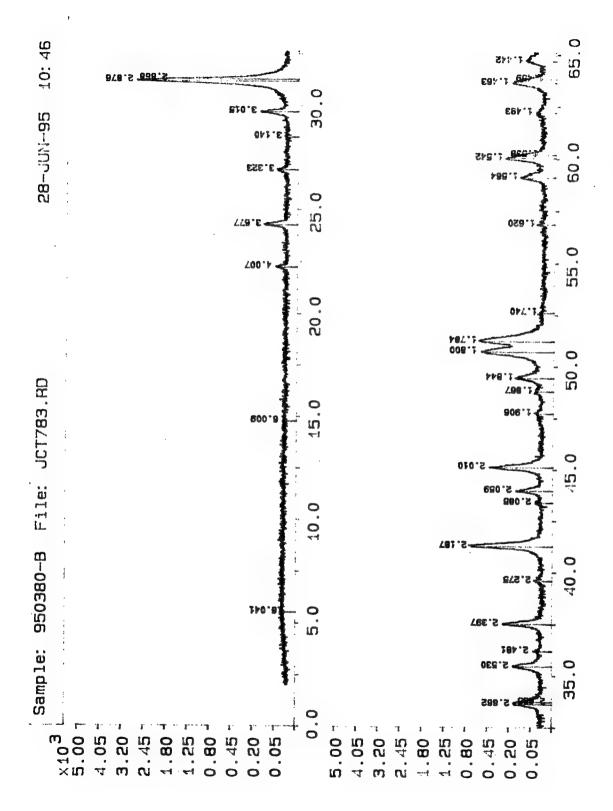


Figure B-33. X-ray diffraction patterns for Sample 950380B

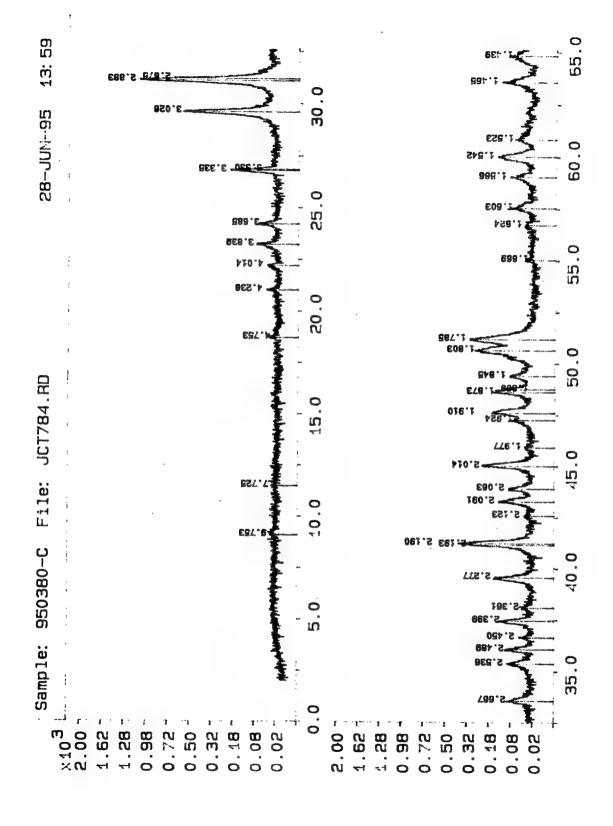


Figure B-34. X-ray diffraction patterns for Sample 950380C

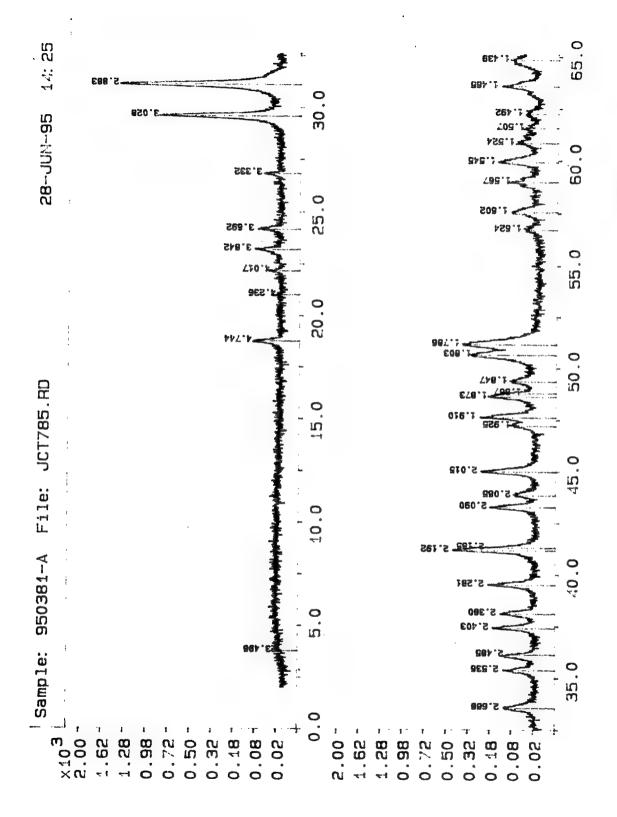


Figure B-35. X-ray diffraction patterns for Sample 950381A

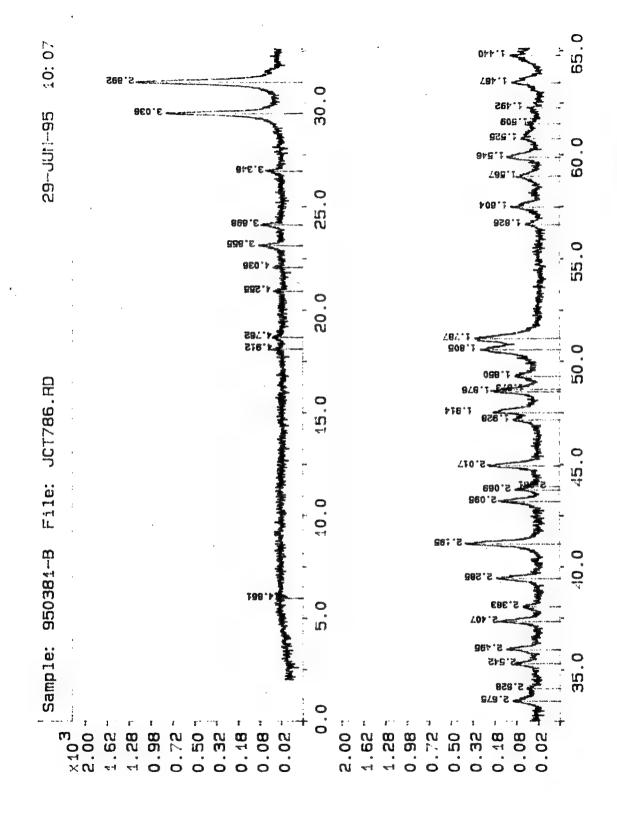


Figure B-36. X-ray diffraction patterns for Sample 950381B

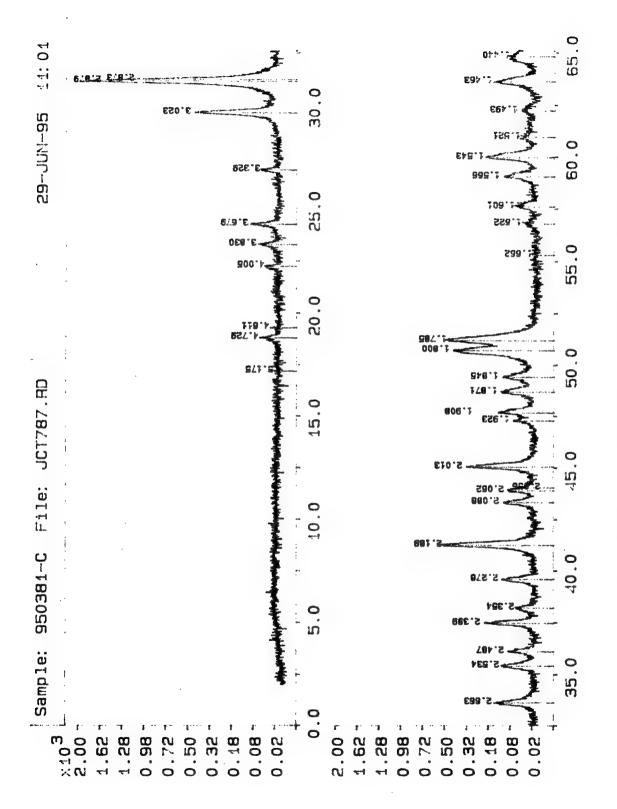


Figure B-37. X-ray diffraction patterns for Sample 950381C

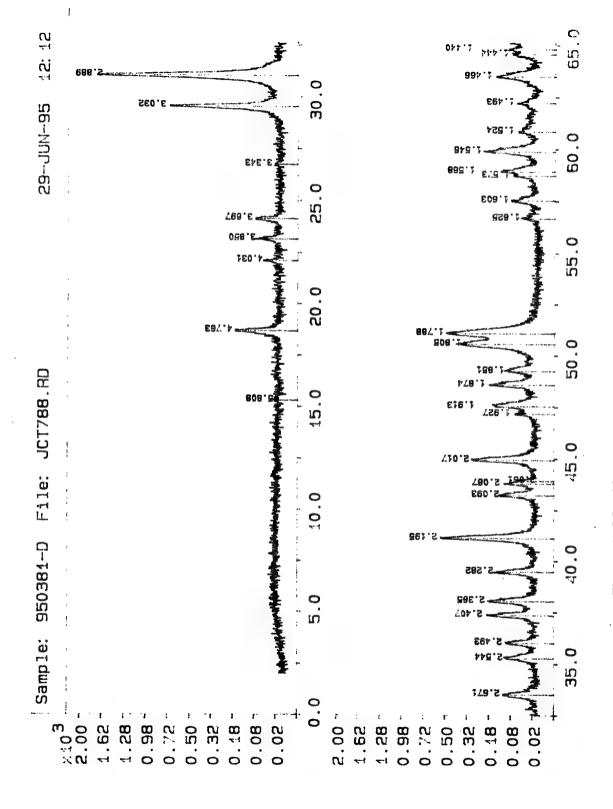


Figure B-38. X-ray diffraction patterns for Sample 950381D

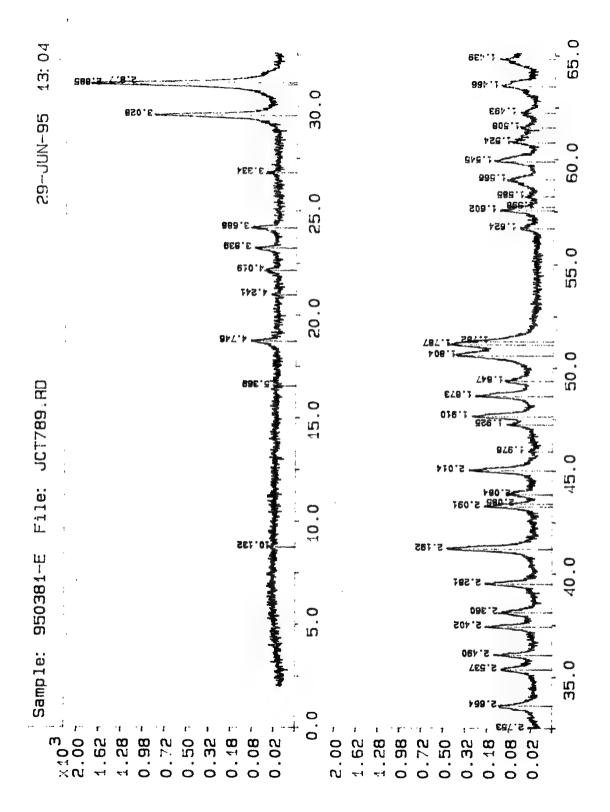


Figure B-39. X-ray diffraction patterns for Sample 950381E

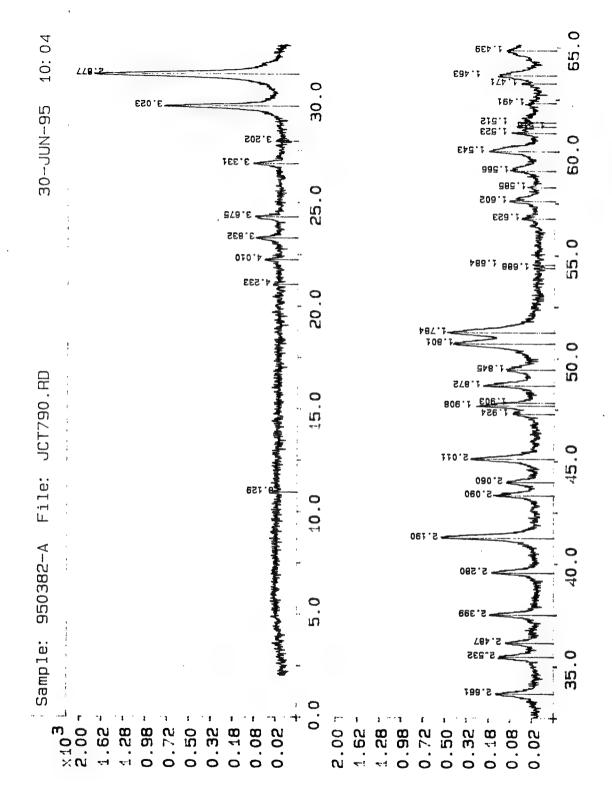


Figure B-40. X-ray diffraction patterns for Sample 950382A

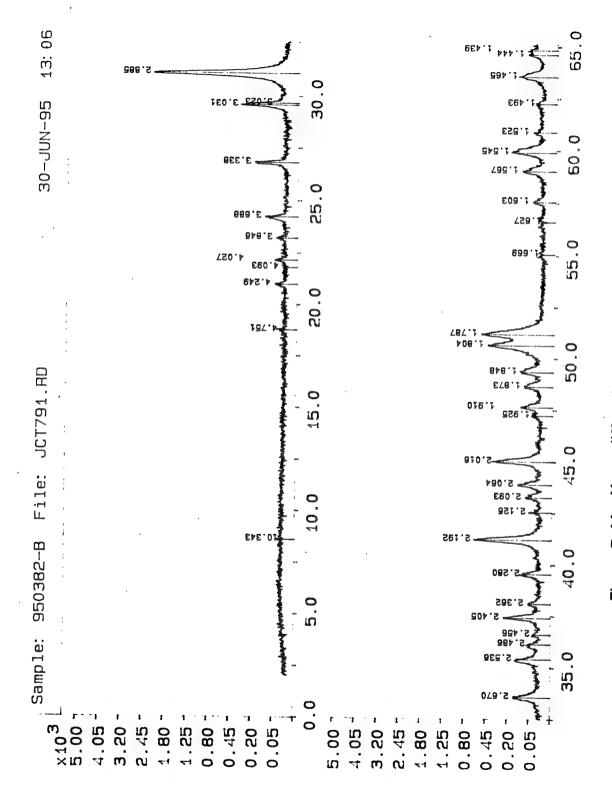


Figure B-41. X-ray diffraction patterns for Sample 950382B

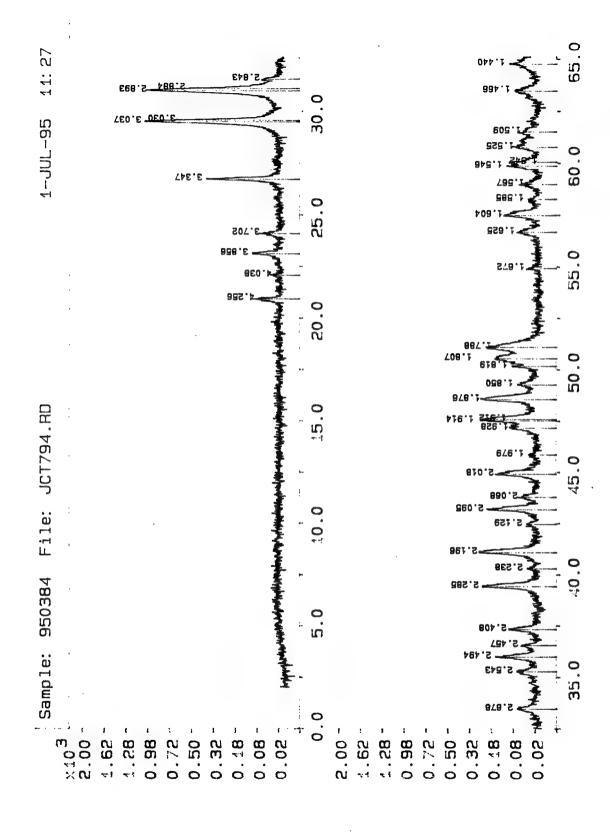


Figure B-42. X-ray diffraction patterns for Sample 950384

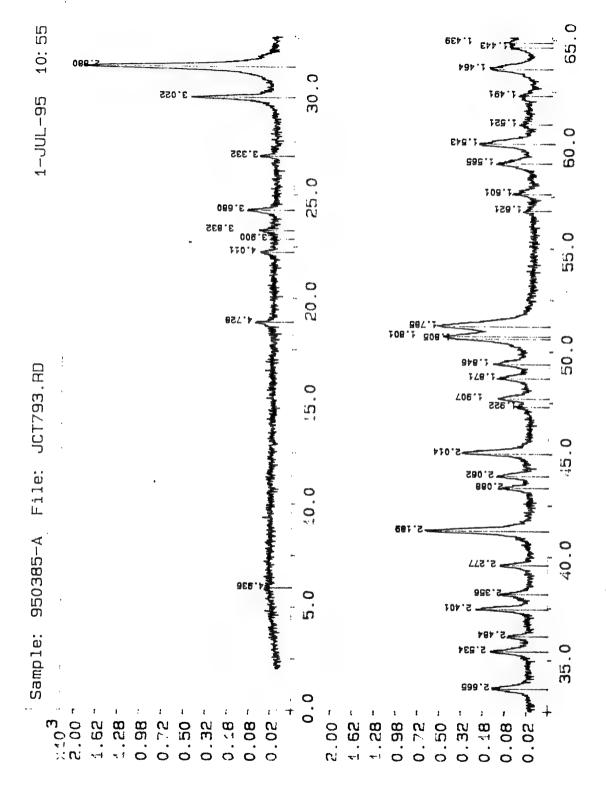


Figure B-43. X-ray diffraction patterns for Sample 950385A

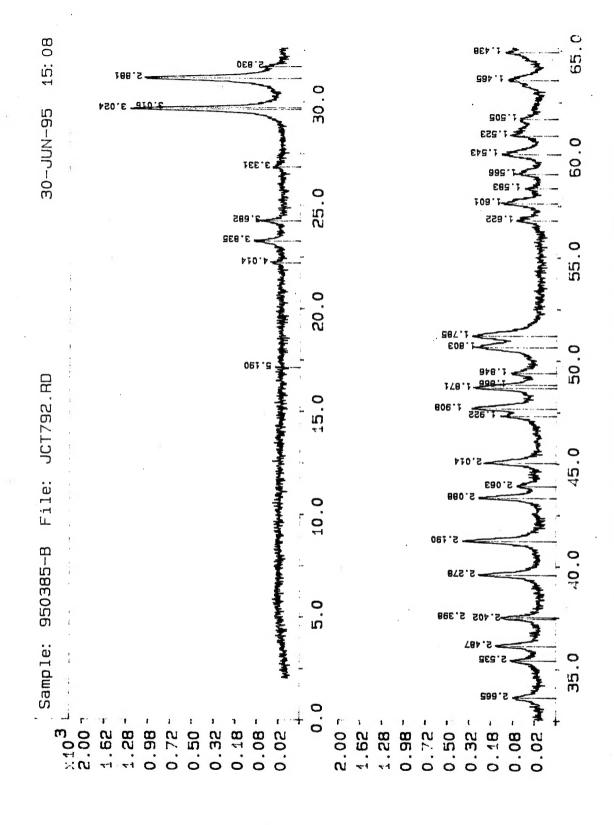


Figure B-44. X-ray diffraction patterns for Sample 950385B

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of Information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC20503.

1.AGENCY USE ONLY (Leave blank)

2.REPORT DATE

3.REPORT TYPE AND DATES COVERED

December 1995

Final report

4.TITLE AND SUBTITLE

Evaluation of Concrete Seawalls at Perry's Victory and International

Peace Memorial

5.FUNDING NUMBERS

6.AUTHOR(S)

Roy L. Campbell, Sr., G. Sam Wong

7.PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Engineer Waterways Experiment Station 3909 Halls Ferry Road Vicksburg, MS 39180-6199

8.PERFORMING ORGANIZATION REPORT NUMBER

Miscellaneous Paper

SL-95-5

9.SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Engineer District, Buffalo 1776 Niagara Street Buffalo, NY 14207-3199

10.SPONSORING/MONITORING AGENCY REPORT NUMBER

11.SUPPLEMENTARY NOTES

Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a.DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b.DISTRIBUTION CODE

13.ABSTRACT (Maximum 200 words)

The U.S. Army Engineer Waterways Experiment Station was requested in the spring of 1995 to evaluate the concrete in the seawalls at Perry's Victory and International Peace Memorial located on South Bass Island at Put-In-Bay, Ohio, in Lake Erie and to report the cause(s) and extent of concrete deterioration an proposed remedial procedures.

A visual and photographic examination of accessible concrete surfaces was performed, ultrasonic pulse velocity measurements made across the top portion of walls, and cores taken from the tops of seawalls in both distressed and nondistressed areas.

It was concluded that the lack of the resistance of the concrete to freezing and thawing while critically saturated was the major contributor to the observed distress and deterioration in the concrete. This conclusion was based on the air-void spacing factor found in core specimens being near or outside the critical limit where the concrete would be considered protected and the presence of some aggregate particles that are susceptible to damage due to freezing and thawing.

All joint seals showed varying degrees of damage, deterioration, and adhesive and cohesive failures. At a few joints, the seal and filler materials were completely missing.

(Continued)

14.SUBJECT TERMS

Air-void spacing factor

Distressed and deteriorated concrete Freezing and thawing deterioration

Photographic examination

Ultrasonic pulse velocity measurements

15.NUMBER OF PAGES

134

16.PRICE CODE

17.SECURITY CLASSIFICATION OF REPORT

UNCLASSIFIED

18.SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

19.SECURITY CLASSIFICATION OF ABSTRACT

20.LIMITATION OF ABSTRACT

298-102

13. (Concluded).

It was recommended that the distressed and deteriorated concrete at 48 locations be considered for removal and replacement. Because of the inadequate air-void system within the remaining concrete, it was recommended that a breathable sealer be applied to monolith faces and reapplied periodically. It was also recommended that existing seals be removed and new seals installed at all joints.

